For official use

THE PATENT OFFICE
G
24 NOV 2004
LONDON

25NOV04 E944094-1 D00389
P10/7700 70.00-0323990.2 CHE
QUE

Reference P18136GB

The Patent Office

REQUEST FOR SUBSTANTIVE EXAMINATION
Form 10/77

Patents Act 1977

Application details

0323990.2

Teledyne Technologies Incorporated

Request

I/We request a substantive examination under Section 18 of the Act.

Signed Forrester Ketley & Co. 24 Nov 04
Forrester Ketley & Co. (Agents)

4145

Patents Form 9/77

Patents Act 1977
(Rules 25, 28 & 32)

THE PATENT OFFICE
13 OCT 2003
RECEIVED

The Patent Office

140CT03 E844309-7 D00389
P09/7700 1.00-0323990.2

9/77

140CT03 E844309-7 D00389
P09/77CIT 15:00-

Request for a preliminary examination and search

(See the notes on the back of this form)

13 OCT 2003

The Patent Office
Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference — P18136GB-NF/jsd

2. Patent application number *(if you know it)* — 0323990.2

3. Full name of the or of each applicant — Teledyne Technologies, Inc.

4. Is this request for:

a) A preliminary examination and search under Section 17(1) for an international application which has been searched in the international phase? *(see note (f))*

b) A preliminary examination and search under Section 17(1) for any other application? — b)

c) A supplementary search under Section 17(8)?

(d) A search of a further invention under Section 17(6)?

(Answer this question by writing (a), (b), (c) or (d)). If your answer is (d), identify the invention to be searched by referring to the claims *(see note (c)).*

5. Do you want any extra copies of any documents cited in the search report? *(see note (d))* — Yes

If so, state how many and remember to pay the extra fee — One

6. Signature — Date

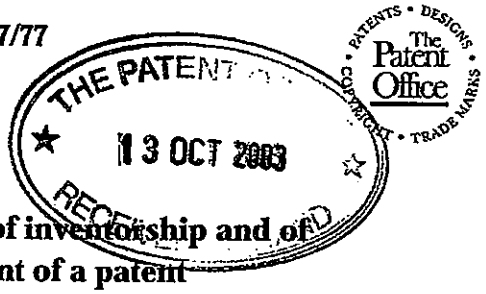
Forrester Ketley & Co. — 10 October 2003

7. Name and daytime telephone number of person to contact in the United Kingdom — (020) 8889 6622 FRANKLAND, Nigel H.

Patents Form 9/77

Patents Form 7/77

Patents Act 1977
(Rule 15)



7/77

Statement of inventorship and of right to grant of a patent

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference	P18136GB-NF/jsd
2. Patent application number *(if you know it)*	0323990.2
3. Full name of the or of each applicant	Teledyne Technologies Inc.,
4. Title of the invention	Improvements in or Relating to Aircraft Avionics Maintenance Diagnostics Data Download Transmission System
5. State how the applicant*(s)* derived the right from the inventor*(s)* to be granted a patent	By virtue of an Assignment dated 9 October 2002
6. How many, if any, additional Patents Forms 7/77 are attached to this form? *(see note (c))*	
7.	I/We believe that the person*(s)* named over the page *(and on any extra copies of this form)* is/are the inventor*(s)* of the invention which the above patent application relates to. Signature: Forrester Ketley & Co. Date: 10 October 2003
8. Name and daytime telephone number of person to contact in the United Kingdom	FRANKLAND, Nigel H. (020) 8889 6622

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.

d) When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.

e) Once you have filled in the form you must remember to sign and date it.

Patents Form 7/77

ents Form 7/77

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

IGLOI, Tamas M.,
4730 Cadison Street,
Torrance, California 90503,
U.S.A.

08733057001

Patents ADP number *(if you know it):*

KARIMI, Ghobad,
19641 Ansdale Drive,
Tarzana, California 91356,
U.S.A.

08733065001

Patents ADP number *(if you know it):*

Patents ADP number *(if you know it):*

Reminder

Have you signed the form?

Patents Form 7/77

Patents Form 7/77

Patents Act 1977
(Rule 15)

THE PATENT OFFICE
★ 13 OCT 2003
RECEIVED BY FAX

The Patent Office
PATENTS • DESIGNS • COPYRIGHT • TRADE MARKS

7/77

Statement of inventorship and of right to grant of a patent

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1.	Your reference	P18136GB-NF/jsd
2.	Patent application number *(if you know it)*	
3.	Full name of the or of each applicant	Teledyne Technologies Inc.,
4.	Title of the invention	Improvements in or Relating to Aircraft Avionics Maintenance Diagnostics Data Download Transmission System
5.	State how the applicant*(s)* derived the right from the inventor*(s)* to be granted a patent	By virtue of an Assignment dated 9 October 2002
6.	How many, if any, additional Patents Forms 7/77 are attached to this form? *(see note (c))*	
7.		I/We believe that the person*(s)* named over the page *(and on any extra copies of this form)* is/are the inventor*(s)* of the invention which the above patent application relates to. Signature: Forrester Ketley & Co Forrester Ketley & Co Date: 10 October 2003
8.	Name and daytime telephone number of person to contact in the United Kingdom	FRANKLAND, Nigel H. (020) 8889 6622

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.

d) When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.

e) Once you have filled in the form you must remember to sign and date it.

Patents Form 7/77

Patents Form 7/77

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

IGLOI, Tamas M.,
4730 Cadison Street,
Torrance, California 90503,
U.S.A.

Patents ADP number *(if you know it):*

KARIMI, Ghobad,
19641 Ansdale Drive,
Tarzana, California 91356,
U.S.A.

Patents ADP number *(if you know it):*

Patents ADP number *(if you know it):*

Reminder

Have you signed the form?

Patents Form 7/77

'ents Form 1/77

Patents Act 1977
(Rule 16)

THE PATENT OFFICE
13 OCT 2003
RECEIVED BY HAND

The Patent Office
PATENTS • DESIGNS • COPYRIGHT • TRADE MARKS

14OCT03 E844309-3 000389?
P01/7700 0.00-0323990.2

1777

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

13 OCT 2003

The Patent Office
Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference
P18136GB-NF/jsd

2. Patent application number
(The Patent Office will fill this part in)
0323990.2

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
Teledyne Technologies, Inc.,
12333 West Olympic Boulevard,
Los Angeles,
California 90064-1021,
U.S.A.

Patents ADP number *(if you know it)*
8733040001

If the applicant is a corporate body, give the country/state of its incorporation
Organised and existing under the laws of the state of Delaware USA

4. Title of the invention
IMPROVEMENTS IN OR RELATING TO AIRCRAFT AVIONICS MAINTENANCE DIAGNOSTICS DATA DOWNLOAD TRANSMISSION SYSTEM

5. Name of your agent *(if you have one)*
Forrester Ketley & Co.

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*
Forrester House
52 Bounds Green Road
London
N11 2EY

Patents ADP number *(if you know it)*
133001

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
US	10/272753	17.10.02

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?
Answer YES if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
Otherwise answer NO (See note d)

Yes

Patents Form 1/77

ents Form 1/77

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	22
Claim(s)	10
Abstract	1
Drawing(s)	9

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	3
Request for a preliminary examination and search (Patents Form 9/77)	1
Request for a substantive examination (Patents Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature(s) Forrester Ketley & Co. Date 10 October 2003

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

FRANKLAND, Nigel h.
(020) 8889 6622
fklondon@forresters.co.uk

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered YES in part 8, a Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

f) Part 7 should only be completed when a divisional application is being made under section 15(4), or when an application is being made under section 8(3), 12(6) or 37(4) following an entitlement dispute. By completing part 7 you are requesting that this application takes the same filing date as an earlier UK application. If you want the new application to have the same priority date(s) as the earlier UK application, you should also complete part 6 with the priority details.

~~33~~ 34

ABSTRACT

"IMPROVEMENTS IN OR RELATING TO AIRCRAFT AVIONICS MAINTENANCE DIAGNOSITCS DATA DOWNLOAD TRANSMISSION SYSTEM"

The present invention resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from an aircraft. The system comprises an aircraft, a cellular infrastructures and a data reception unit. The aircraft has an avionics system and a communications unit. The avionics system comprises a plurality of line replaceable units, and the communications unit is connected to each line replaceable unit. The cellular infrastructure is in communication with said communications unit after the aircraft has landed. The communication is initiated automatically upon the landing of the aircraft. The data reception unit is connected to the cellular infrastructure.

[FIGURE 1]

S.W.E.
19/3/04

(12) UK Patent Application (19) GB (11) 2 395 634 (13) A

(43) Date of A Publication 26.05.2004

(21) Application No: 0323990.2

(22) Date of Filing: 13.10.2003

(30) Priority Data:
(31) 10272753 (32) 17.10.2002 (33) US

(71) Applicant(s):
Teledyne Technologies Inc
(Incorporated in USA - Delaware)
12333 West Olympic Boulevard,
Los Angeles, California 90064-1021,
United States of America

(72) Inventor(s):
Tamas M Igloi
Ghobad Karimi

(74) Agent and/or Address for Service:
Forrester Ketley & Co
Forrester House, 52 Bounds Green Road,
LONDON, N11 2EY, United Kingdom

(51) INT CL[7]:
G06F 17/40 // H04L 29/00

(52) UK CL (Edition W):
H4L LRAXX

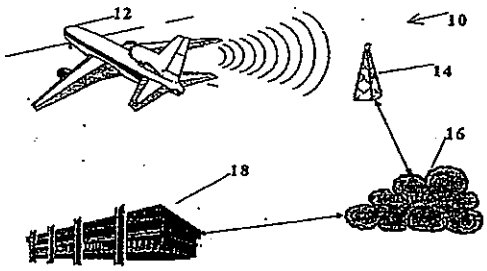
(56) Documents Cited:
GB 2345824 A
US 6308045 B1
US 6108523 A
EP 1280316 A3
US 6181990 B1
US 5974349 A

(58) Field of Search:
UK CL (Edition W) H4L
INT CL[7] G06F, H04L
Other: Online: WPI, JAPIO, EPODOC

(54) Abstract Title: **Improvements in or relating to aircraft avionics maintenance diagnostics data download transmission system**

(57) The present invention resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from an aircraft. The system comprises an aircraft, a cellular infrastructures and a data reception unit. The aircraft has an avionics system and a communications unit. The avionics system comprises a plurality of line replaceable units, and the communications unit is connected to each line replaceable unit. The cellular infrastructure is in communication with said communications unit after the aircraft has landed. The communication is initiated automatically upon the landing of the aircraft. The data reception unit is connected to the cellular infrastructure.

FIGURE 1



GB 2 395 634 A

Original Printed on Recycled Paper

B DOC PRINTERS REPORT

(11)2395634
(54)Grant Title
Improvements in or relating to aircraft avionics maintenance diagnostics data download transmission system

(51)INT CL
!G06F 17/40! (2006.01)
!H04L 29/00! (2006.01)

(21)Application No 0323990.2 (22)Date of Filing 13.10.2003

(30)Priority Data
(31)10272753 (32)17.10.2002 (33)US

(43)Date A Publication 26.05.2004
(45)Date B Publication 26.07.2006

(52)UK CL(Edition X)
H4L LRAXA L205

(56)Documents Cited
GB2345824 A ; EP1280316 A3 ; WO2003/092310 A1 ; US6308045 B1
US6181990 B1 ; US6108523 A ; US5974349 A

(58) Field of Search
UK CL(Edition W)
H4L
INT CL 7
G06F , H04L
Other
Online: WPI, JAPIO, EPODOC

Additional Fields
UK CL(Edition X)
H4L
INT CL 7
G06F , H04L

(72)Inventor(s)
Tamas M Igloi

Ghobad Karimi

(73)Proprietor(s)
Teledyne Technologies Inc, Incorporated in USA - Delaware, 12333 West Olympic Boulevard, Los Angeles, California 90064-1021, United States of America

(74)Agent and/or Address for Service
Forrester Ketley & Co, Forrester House, 52 Bounds Green Road, LONDON, N11 2EY, United Kingdom

(12) UK Patent (19) GB (11) 2 395 634 (13) B

(45) Date of publication: 26.07.2006

(54) Title of the invention: Improvements in or relating to aircraft avionics maintenance diagnostics data download transmission system

(51) INT CL: G06F 17/40 (2006.01) H04L 29/00 (2006.01)

(21) Application No: 0323990.2

(22) Date of Filing: 13.10.2003

(30) Priority Data:
(31) 10272753 (32) 17.10.2002 (33) US

(43) Date A Publication: 26.05.2004

(52) UK CL (Edition X):
H4L LRAXA L205

(56) Documents Cited:
GB 2345824 A
WO 2003/092310 A1
US 6181990 B1
US 5974349 A
EP 1280316 A3
US 6308045 B1
US 6108523 A

(58) Field of Search:
As for published application 2395634 A *viz:*
UK CL (Edition W) H4L
INT CL[7] G06F, H04L
Other: Online: WPI, JAPIO, EPODOC
updated as appropriate

Additional Fields
UK CL (Edition X) H4L
INT CL[7] G06F, H04L

(72) Inventor(s):
Tamas M Igloi
Ghobad Karimi

(73) Proprietor(s):
Teledyne Technologies Inc
(Incorporated in USA - Delaware)
12333 West Olympic Boulevard,
Los Angeles, California 90064-1021,
United States of America

(74) Agent and/or Address for Service:
Forrester Ketley & Co
Forrester House, 52 Bounds Green Road,
LONDON, N11 2EY, United Kingdom

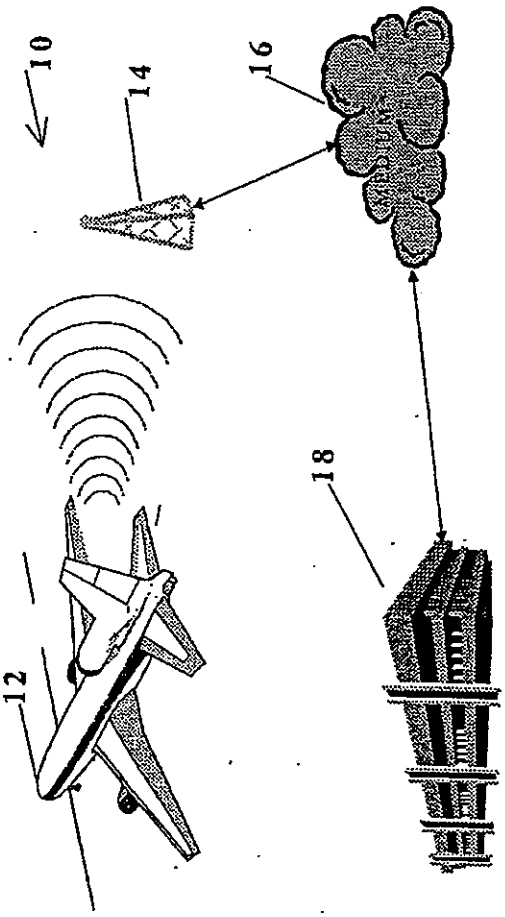


FIGURE 1

2/9

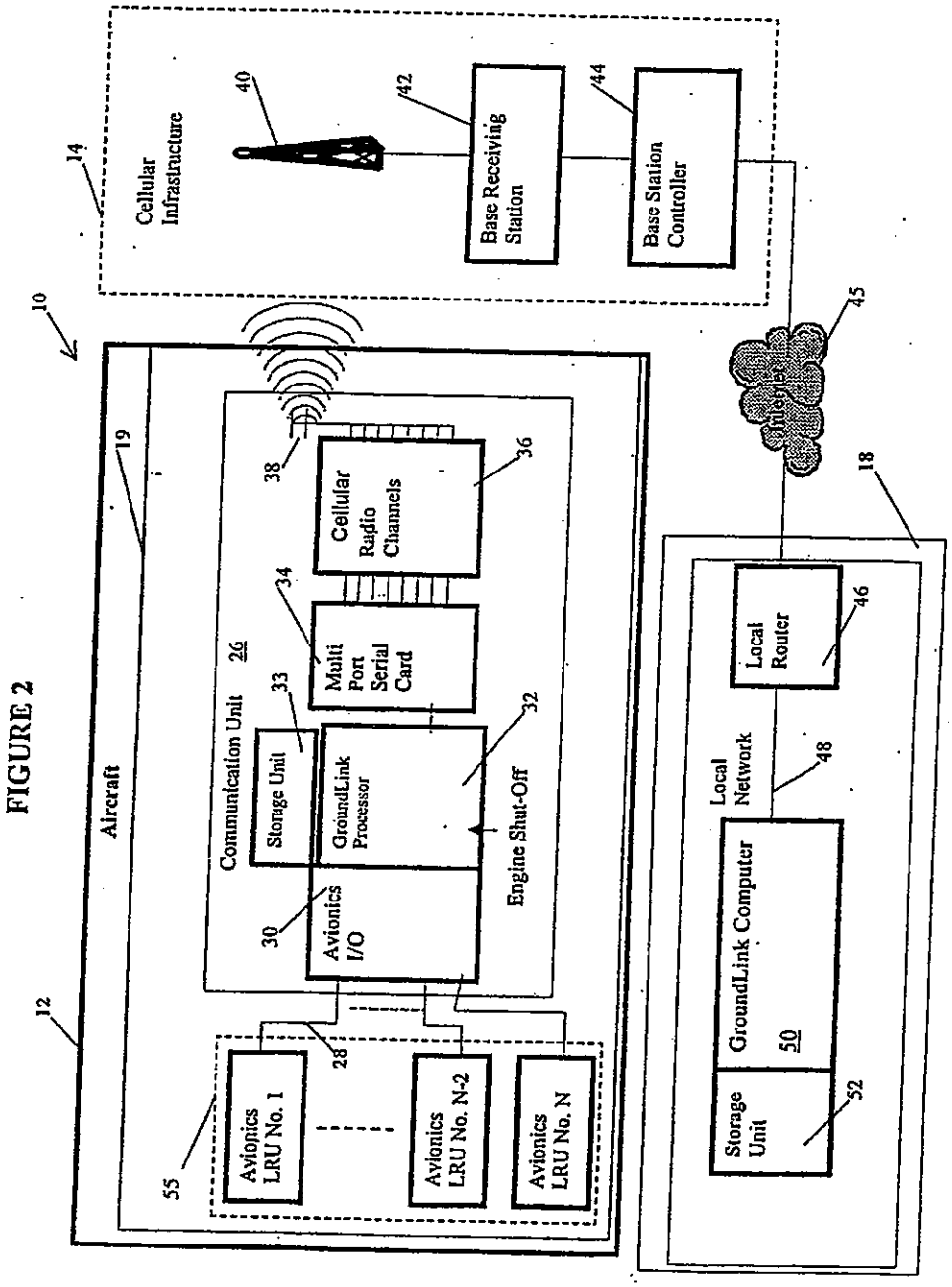
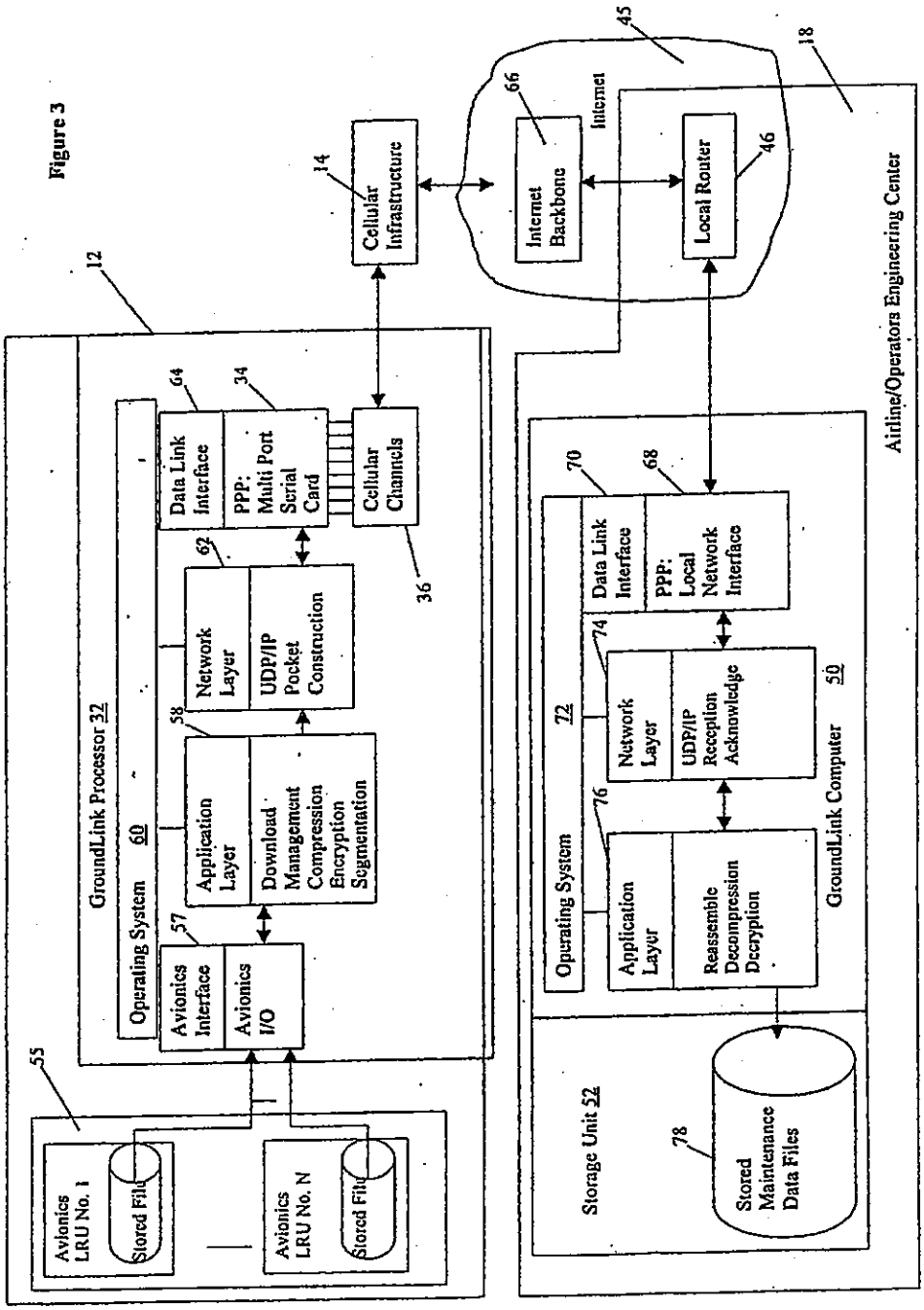

Cellular Infrastructure
14
40
42
Base Receiving Station
44
Base Station Controller
10
45
Internet
18
19
Aircraft
38
Cellular Radio Channels
36
34
Multi Port Serial Card
Communication Unit 26
33
Storage Unit
GroundLink Processor
32
Engine Shut-Off
30
Avionics I/O
12
28
55
Avionics LRU No. 1
Avionics LRU No. N-2
Avionics LRU No. N
Local Router
46
Local Network
48
GroundLink Computer
50
Storage Unit
52

FIGURE 2

3/9

Figure 3


Airline/Operators Engineering Center
18
Internet
45
Internet Backbone
66
Local Router
46
Cellular Infrastructure
14
12
GroundLink Processor 32
Operating System 60
Data Link Interface
64
PPP: Multi Port Serial Card
34
Cellular Channels
36
Network Layer
62
UDP/IP Packet Construction
Application Layer
58
Download Management Compression Encryption Segmentation
Avionics Interface
57
Avionics I/O
55
Avionics LRU No. 1
Stored File
Avionics LRU No. N
Stored File
GroundLink Computer 50
Operating System 72
Data Link Interface
70
PPP: Local Network Interface
68
Network Layer
74
UDP/IP Reception Acknowledge
Application Layer
76
Reassemble Decompression Decrypion
Storage Unit 52
Stored Maintenance Data Files
78

4/9

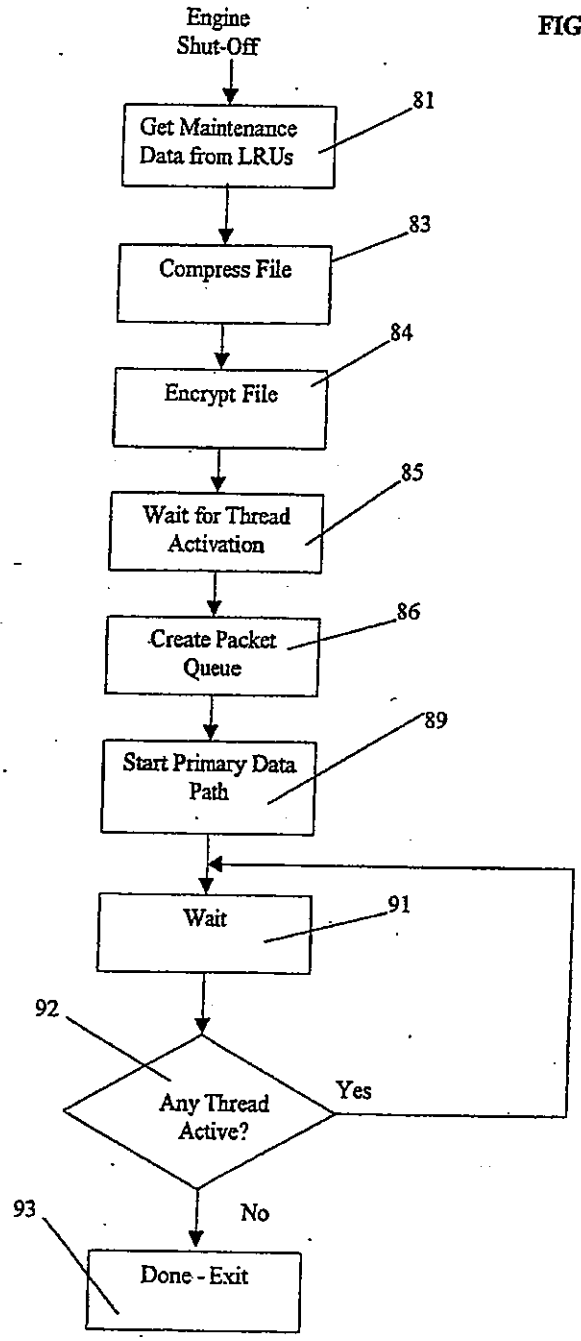
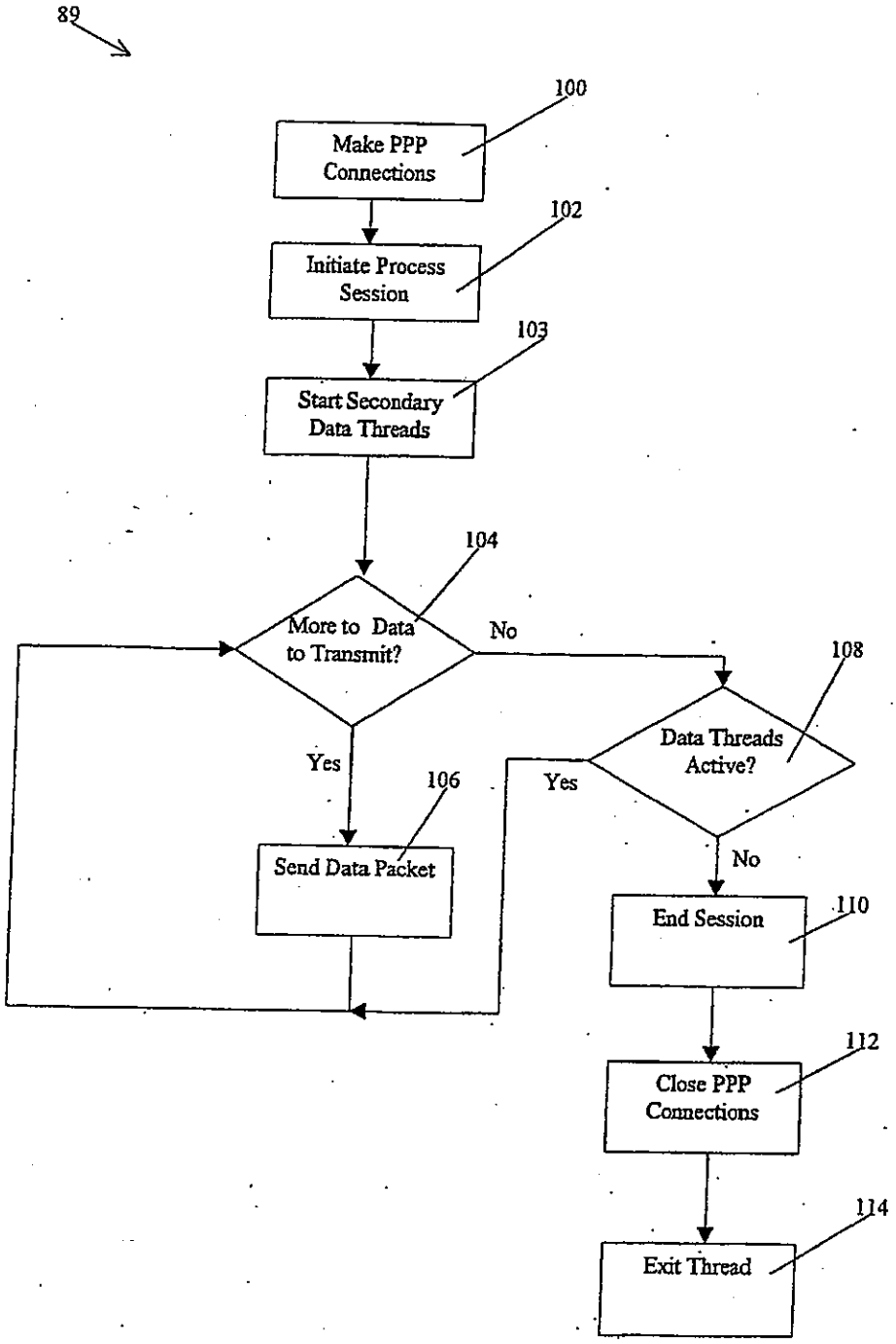

Engine Shut-Off
Get Maintenance Data from LRUs
81
Compress File
83
Encrypt File
84
Wait for Thread Activation
85
Create Packet Queue
86
Start Primary Data Path
89
Wait
91
92
Any Thread Active?
Yes
No
93
Done - Exit

FIGURE 4

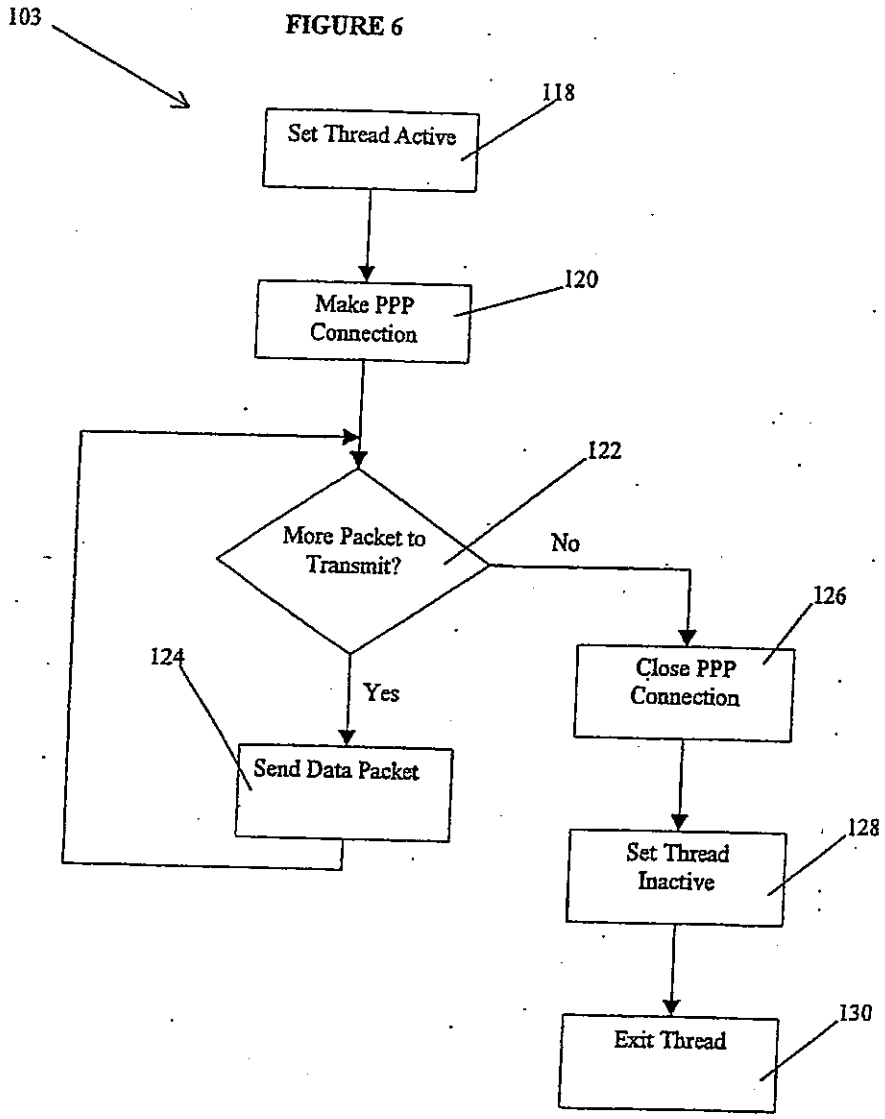
5/9

FIGURE 5


89
100
Make PPP Connections
102
Initiate Process Session
103
Start Secondary Data Threads
104
More to Data to Transmit?
No
Yes
106
Send Data Packet
108
Data Threads Active?
Yes
No
110
End Session
112
Close PPP Connections
114
Exit Thread

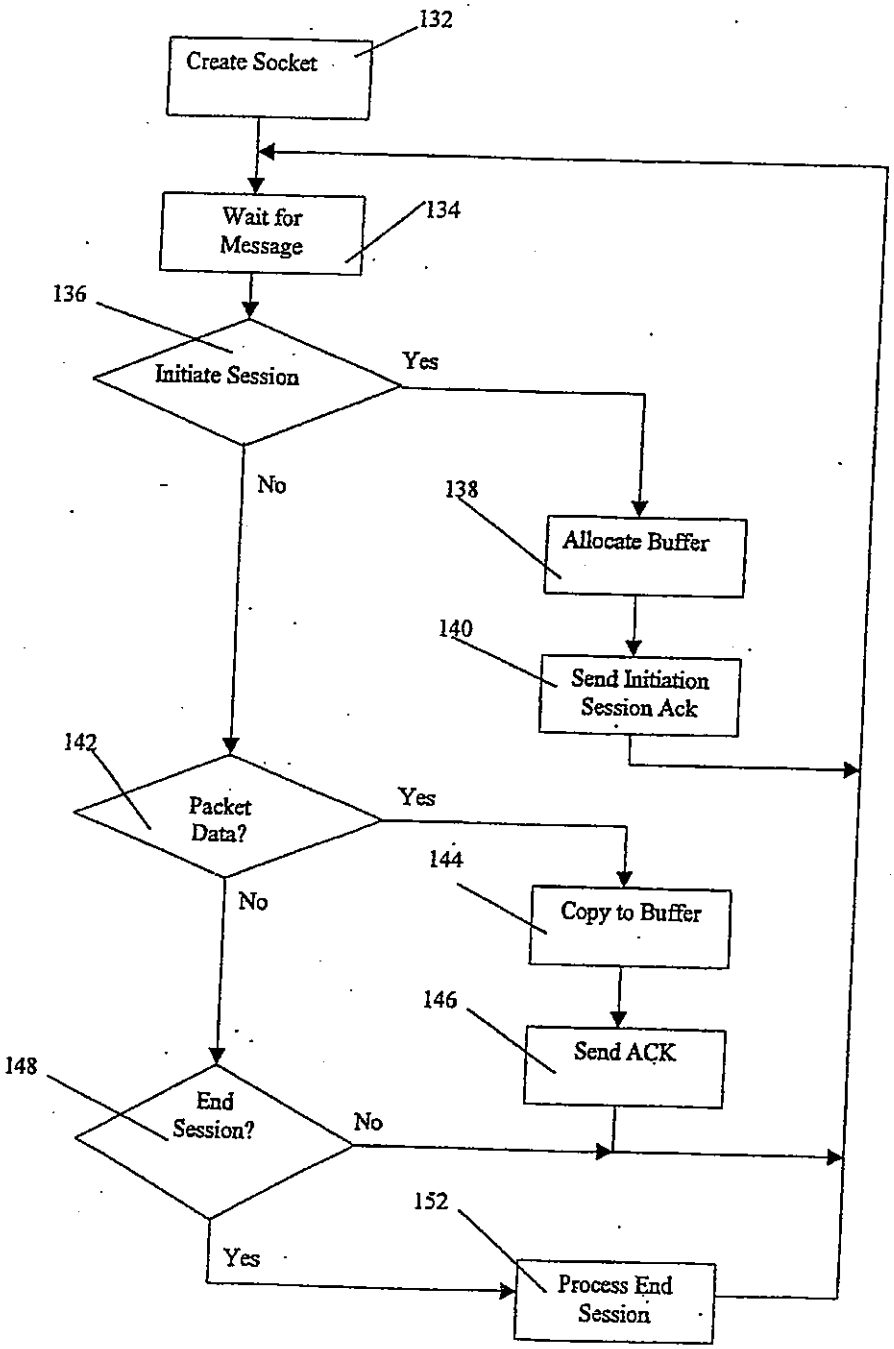
6/9

FIGURE 6


103
118
Set Thread Active
120
Make PPP Connection
122
More Packet to Transmit?
No
Yes
124
Send Data Packet
126
Close PPP Connection
128
Set Thread Inactive
130
Exit Thread

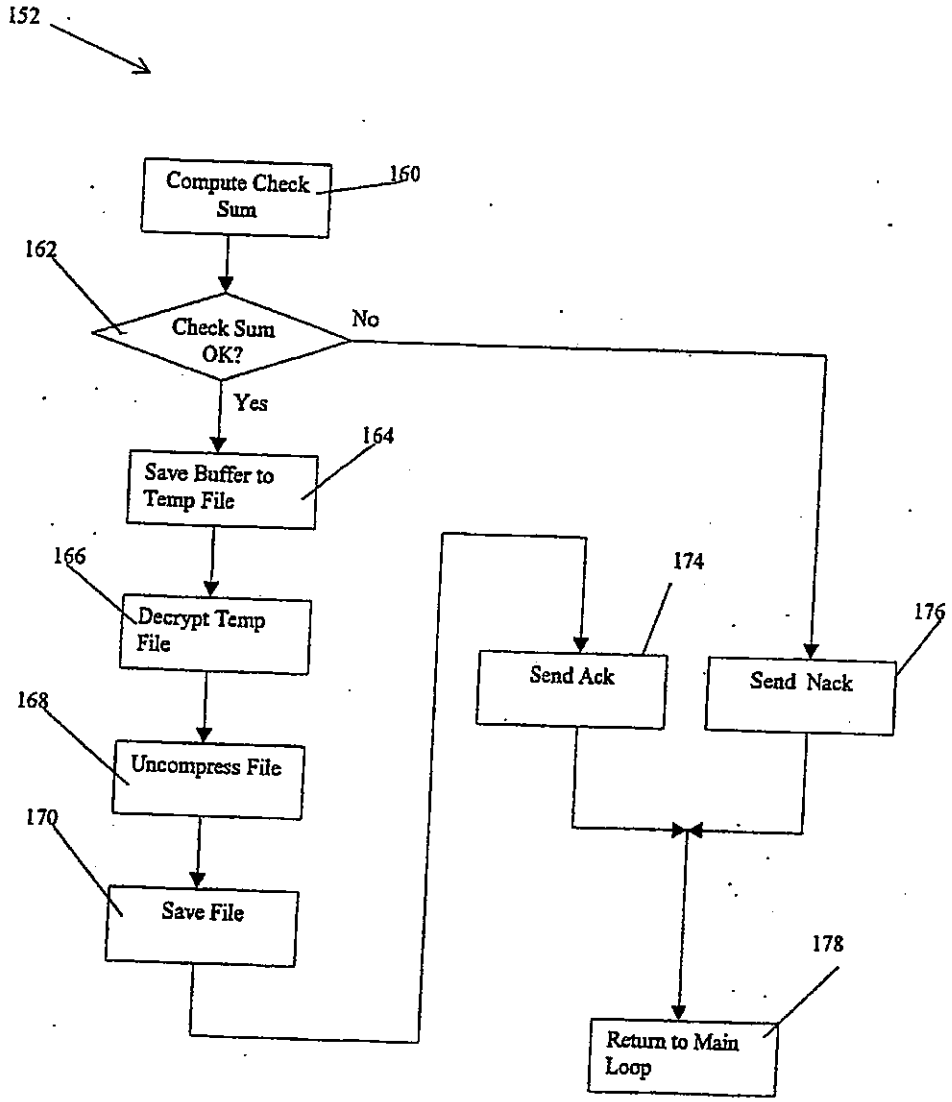
7/9

FIGURE 7


132
Create Socket
Wait for Message
134
136
Initiate Session
Yes
No
138
Allocate Buffer
140
Send Initiation Session Ack
142
Packet Data?
Yes
144
Copy to Buffer
No
146
Send ACK
148
End Session?
No
152
Yes
Process End Session

8/9

FIGURE 8


152
Compute Check Sum
160
162
Check Sum OK?
No
Yes
164
Save Buffer to Temp File
166
Decrypt Temp File
168
Uncompress File
170
Save File
174
Send Ack
176
Send Nack
178
Return to Main Loop

9/9

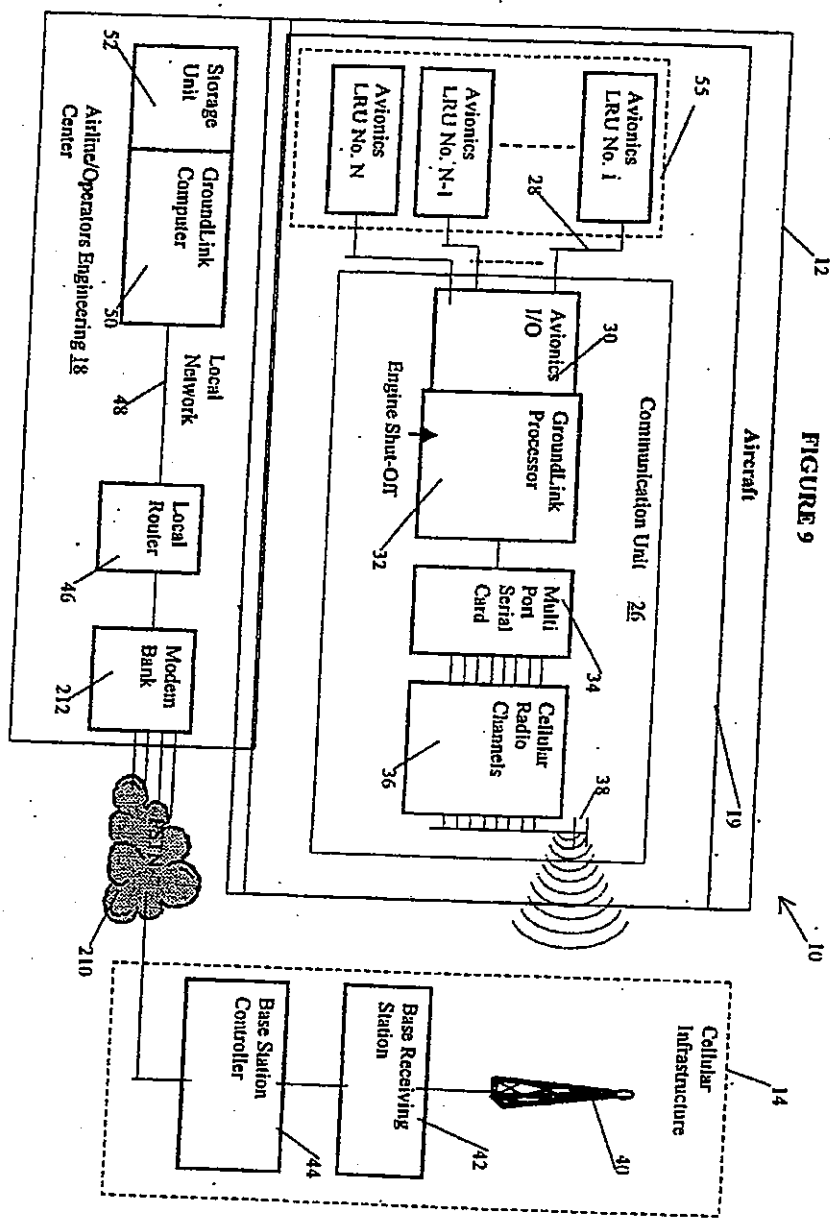

Avionics LRU No. 1
Avionics LRU No. N-1
Avionics LRU No. N
55
28
12
Aircraft
Avionics I/O
30
GroundLink Processor
Engine Shut-Off
32
Communication Unit 26
Multi Port Serial Card
34
Cellular Radio Channels
36
38
19
10
Storage Unit
52
GroundLink Computer
50
Airline/Operators Engineering 18 Center
Local Network
48
Local Router
46
Modem Bank
212
210
Base Station Controller
44
Base Receiving Station
42
40
Cellular Infrastructure
14

FIGURE 9

DESCRIPTION OF INVENTION

"IMPROVEMENTS IN OR RELATING TO AIRCRAFT AVIONICS MAINTENANCE DIAGNOSTICS DATA DOWNLOAD TRANSMISSION SYSTEM"

THE PRESENT INVENTION is directed generally to an aircraft maintenance/diagnostics data transmission system and, more particularly, to an on-board cellular data transmission/reception system operable in conjunction with maintenance/diagnostics data transmission over public telephone networks and the Internet.

It is common for aircraft avionics and electronic engine control systems to require download of maintenance/diagnostic data for maintenance purposes. Presently, most aircraft utilized in passenger, freighter and business categories require some degree of diagnostic data download from one or more avionics and engine control equipment, such as an Electronic Engine Computer (EEC), Data Encryption Unit (DEU), Flight Management Computer (FMC), etc. These downloads are currently accomplished manually by connecting a download device to the aircraft, or using permanently installed maintenance/diagnostics terminals. The diagnostic information is transferred from the avionics equipment to storage media, such as floppy disks or CD-ROMs. Upon completion of the transfer from the avionics unit to the

storage media, the maintenance/diagnostic information is transferred to the maintenance centre of the airline for processing.

The current manual download includes the human as an active component of this activity. The steps include the downloading to a media, delivery of the media to the maintenance facilities and transfer of the data from the media to a maintenance computer for analysis.

Computer systems are typically used to analyse and manage the aircraft maintenance/diagnostics for the aircraft. Such systems require manual transportation of the down load media from each aircraft to the maintenance centre.

Often times, radio frequency (RF) transmissions are used to transmit maintenance/diagnostic data relating to an aircraft. This technique, however, requires substantial investments to construct the RF transmission systems required for such a system to work. Furthermore, it is very expensive to create redundancy in such a system. Maintenance/diagnostic data can also be transmitted to an aircraft via a telephone system located in a terminal. Such a system, however, requires that the aircraft be docked at the gate before transmission begins, thereby resulting in not being able to transfer uploads to aircraft that are routinely parked on the tarmac, away from the gates when loading and unloading passengers and cargo. Furthermore, such a system requires an added step of transmitting the download maintenance/diagnostic data from the telephone system to the maintenance centre, increasing the cost of installing, operating, and maintaining such a system.

Thus, there is a need for an aircraft maintenance/diagnostics download system that automatically transfers aircraft/engine and maintenance/diagnostic

The Patent Office
PATENTS • DESIGNS • COPYRIGHT • TRADE MARKS

INVESTOR IN PEOPLE

Teledyne Technologies Inc
c/o Forrester Ketley & Co
Forrester House
52 Bounds Green Road
LONDON
N11 2EY

The Patent Office
Patents Directorate

Concept House
Cardiff Road
Newport
South Wales NP10 8QQ
United Kingdom

Direct line: 08459 500505
Switchboard: 01633 814000
Fax: 01633 814827
Minicom: 08459 222250
DX 722540/41 Cleppa Park 3
http://www.patent.gov.uk

Your Reference: P18136GB-NF/jsd
Our Reference:

26 April 2004

Dear Sir/Madam

PATENTS ACT 1977: PATENTS RULES 1995
NOTICE OF PUBLICATION: APPLICATION NUMBER GB0323990.2

1. Your patent application will be published on **26 May 2004** with the publication number **GB2395634**. Preparations for publication will be complete (PPC) on **30 April 2004**. **WARNING** - after preparations for publication are complete it will NOT be possible to withdraw your application from publication. If you wish to withdraw your application to prevent publication you should do so BEFORE the PPC date. The withdrawal should be in writing to the address above or by email to withdraw@patent.gov.uk. Further information on withdrawing applications can be obtained from the Publication Liaison Officer by telephone on 01633 814089.

2. On the publication date, details of your application will be entered in the Register of Patents. From then onwards those details, and the application file, will be open to public inspection at the Patent Office, Concept House, Cardiff Road, Newport, South Wales, NP10 8QQ and at the Patent Office, Harmsworth House, 13-15 Bouverie Street, London, EC4Y 8DP.

3. IMPORTANT: If you want your application considered for grant of a patent, you must, if you have not already done so, ensure that a request for substantive examination on Patents Form 10/77, together with the required fee (currently **£70.00**), is received by the Patent Office within 6 months of the publication date, that is by **26 November 2004**. That period can be extended by one month by sending us Patents Form 52/77, together with the required additional fee (currently **£135.00**).

4. IMPORTANT: If the request and fee for substantive examination are not received by the Patent Office in time, your application will be treated as withdrawn.

[PLEASE TURN OVER]

5. The information in paragraph 3 does not apply to substantive examination of either a "divisional" application made under Section 15(4) of the Act, or a patent application made following entitlement proceedings. If you would like further information, or if you would like us to send you a blank Patents Form 10/77 (or Patents Form 52/77), please telephone our enquiry number, 08459 500505.

6. You will be sent one free copy of the published application. Further copies may be bought from the Patent Office (Sales), Concept House, Cardiff Road, Newport, South Wales, NP10 8QQ and also, for a limited period from the Patent Office, Harmsworth House, 13-15 Bouverie Street, London EC4Y 8DP. If you want to know the prices of publications, you should telephone sales on 01633 814842. If you order extra copies of your published application, please quote the publication number shown in paragraph 1 above, followed by the suffix "A".

Yours faithfully

Kurt Stephens
Publishing Section

Thus, there is a need for an aircraft maintenance/diagnostics download system that automatically transfers aircraft/engine and maintenance/diagnostic data to the airline's or operator's maintenance and engineering centre with little or no human involvement, and which relies on a widely available and reliable public wireless, public switch telephone network (PSTN), integrated services digital network (ISDN), and/or Internet delivery systems.

The present invention, which addresses this need, resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from aircraft.

According to one aspect of this invention there is provided an aircraft maintenance and diagnostic data download system, comprising:

an aircraft having an avionics system and a communication unit, wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data, and wherein the communications unit is connected to one or more avionics and/or electronic engine control line replaceable units;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit, connected to the cellular infrastructure, wherein the data reception unit is remotely located from the aircraft, and wherein the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

Advantageously said data reception unit is in communication with said cellular infrastructure via a computer network.

Preferably the computer network is the Internet.

Conveniently said data reception unit is in communication with said cellular infrastructure via a telephone network.

Preferably the telephone network is a public switch telephone network.

Advantageously the telephone network is an integrated services digital telephone network.

Preferably said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

a multi-port serial card in communication with said processor;

a plurality of cell channels in communication with said multi-port serial card; and

one or more antennas in communication with said cell channels.

Conveniently said cellular infrastructure includes:

an antenna;

a transceiver subsystem in communication with said antenna; and

a controller in communication with said transceiver subsystem.

Advantageously said data reception unit includes:

a router; and

a processor in communication with said router, said processor having a storage unit.

According to another aspect of this invention there is provided an aircraft maintenance and diagnostic data download system, comprising:

an avionics system that comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data;

an avionics input/output interface that is connected each of the avionics and/or electronic engine control line replaceable units;

a processor that is connected to the avionics input/output interface;

a multi-port serial card that is connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit via a cellular infrastructure after the aircraft has landed, wherein the data reception unit is remotely located from the aircraft, and wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

The system may further comprise one or more antennas in communication with said cell channels.

Advantageously the processor is a personal computer.

Alternatively the processor is an application specific integrated circuit.

Alternatively the processor is a microprocessor.

The invention also relates to an aircraft, comprising:

an avionics system having a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data; and

a communication unit, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and the communication unit is connected to one or more of the avionics and/or electronic engine control line replaceable units, and wherein the communication unit comprises:

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

The invention further relates to an aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

means for transmitting aircraft maintenance and diagnostic data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft, and wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable units stores the aircraft maintenance and diagnostic data; and

means for receiving said data from said cellular infrastructure.

Conveniently said means for transmitting data includes a processor.

Preferably said means for receiving data includes a processor.

The invention also relates to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality avionics and/or electronic engine control line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

In a further embodiment the invention relates to a method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

processing maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

The method may further comprise receiving said transmitted data at a flight operations centre.

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a computer network.

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a telephone network.

Preferably processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

Conveniently receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

reassembling said received data;

decrypting said reassembled data;

uncompressing said decrypted data; and

storing said uncompressed data.

The invention may be considered to relate to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft [illegible] infrastructure after the aircraft has landed, wherein processing said data includes;

receiving a signal which indicates that the data downloading process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

creating a packet queue;

staring a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

Preferably starting a primary data thread includes:

initiating a PPP connection;

initiating a transfer session;

starting at least one secondary data thread;

determining if data remains in the primary data thread;

sending said data when data remains in the primary data thread;

determining if data threads are active when no data remains in the primary data thread;

repeating, when said threads are active, the step of determining if data remains in the primary data thread;

ending said session when no threads are active;

closing said PPP connection; and

exiting starting a primary data thread.

Conveniently starting at least one secondary data thread includes:

(a) setting the secondary data thread to active;

(b) initiating a PPP connection;

(c) determining if data remains in the secondary data thread;

(d) sending a data packet when data remains;

(e) repeating step c when data remains;

(f) closing said PPP connection when no data remains;

(g) setting the secondary data thread to inactive;

(h) exiting starting at least one secondary data thread; and

(i) repeating steps a through h for each secondary data thread.

Advantageously repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

The invention also relates to a computer-implemented method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed data via a cellular infrastructure after the aircraft has landed; and

receiving the downloaded maintenance and diagnostic data at a ground operations centre, wherein receiving said downloaded maintenance and diagnostic data includes;

creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is an end session, and repeating, when said message is not an end session message, the step of receiving a message.

Preferably initiating a session includes:

allocating buffer space;

sending an initiation session acknowledgement; and

returning to receiving a message.

Advantageously processing said message when said message is a data message includes:

copying said message to a buffer;

sending a data message acknowledgement; and

returning to receiving a message.

Preferably processing said message when said message is not an end session includes:

computing a checksum;

determining if said checksum is valid;

saving a buffer to a temporary file;

decrypting said temporary file;

uncompressing said temporary file;

sending an end session acknowledgement; and

returning to receiving a message.

The invention also relates to an article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of downloading maintenance and diagnostic data from an avionics systems located on an aircraft, the method comprising:

receiving maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

processing said maintenance and diagnostic data to prepare said data for downloading; and

downloading said processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure when said aircraft has landed, wherein said cellular infrastructure is accessed automatically upon landing of the aircraft.

The system comprises an aircraft, a cellular infrastructures and a data reception unit. The aircraft has an avionics system and a communications unit. The avionics system comprises a plurality of line replaceable units. The communications unit is connected to each line replaceable unit. The cellular infrastructure is in communication with said communications unit after the aircraft has landed. The communication is initiated automatically upon the landing of the aircraft. The data reception unit is connected to the cellular infrastructure.

The preferred embodiment of the present invention represents a substantial advance over prior aircraft data download systems. For example, the present invention has the advantage that it requires little expense to implement because it uses well-known cellular technology, cellular infrastructure, telephone networks and computer networks, which are already in place. The preferred embodiment of the present invention also has the advantage that it can transmit the diagnostic data over one or more channels to achieve the necessary transmission bandwidth and achieve a low data transmission time. The preferred embodiment of the present invention has the further advantage that it does not require a dedicated data link between the aircraft and the airline/aircraft operator engineering centre and/or an airport terminal.

For the present invention to be clearly understood and readily practised, the present invention will be described in conjunction with the following figures, in which like reference numbers represent corresponding parts throughout:

FIGURE 1 illustrates an exemplary aircraft maintenance data download and transmission system, in accordance with an embodiment of the present invention;

FIGURE 2 is a block diagram illustrating a more detailed embodiment of the system illustrated in FIGURE 1, in accordance with an embodiment of the present invention;

FIGURE 3 is a block diagram illustrating data flow through the system illustrated in FIGURE 2, in accordance with an embodiment of the present invention;

FIGURE 4 is a flowchart illustrating a method carried out by the GroundLink processor in the aircraft, in accordance with an embodiment of the present invention;

FIGURE 5 is a flowchart illustrating a method of performing the start secondary data threads and transmitting data packet step 89 of FIGURE 4, in accordance with an embodiment of the present invention;

FIGURE 6 is a flowchart illustrating a method of performing the start secondary data threads step 103 of FIGURE 5, in accordance with an embodiment of the present invention;

FIGURE 7 is a flowchart illustrating a method of operating the GroundLink computer in the airlines/operators engineering centre, in accordance with an embodiment of the present invention;

FIGURE 8 is a flowchart illustrating a method of performing the process end of session step 152 of FIGURE 7, in accordance with an embodiment of the present invention;

FIGURE 9 is a block diagram illustrating another embodiment of the system illustrated in FIGURE 1.

In the following description, reference is made to the accompanying drawings which form a part hereof, and which is shown only by way of illustration a specific embodiment in which the invention may be practised. It is to be understood that other embodiments may be utilized and changes may be made without departing from scope of the present invention.

It is to be understood that the figures and descriptions of the present invention have been simplified to illustrate elements that are relevant for a clear understanding of the present invention, while eliminating, for purposes of clarity, other elements found in a typical communications system. It can be recognised that other elements are desirable and/or required to implement a device incorporating the present invention. For example, the details of the avionics and engine maintenance data download method, the cellular communications infrastructure, the Internet, and the public-switched telephone network are not disclosed. However, because such elements are well known in the art, and because they do not facilitate a better understanding of the present invention, a discussion of such elements is not provided herein.

FIGURE 1 illustrates an exemplary aircraft transmission/reception of avionics and engine maintenance/diagnostic data download system 10, in accordance with an embodiment of the present invention. An aircraft 12, which has stored avionics and electronic engine control units maintenance/diagnostics data, is illustrated after landing. The aircraft 12 transmits maintenance/diagnostics data as cellular communications signals over a cellular infrastructure 14. The cellular infrastructure 14 acts as a communications channel to the communications medium 16. Airline/operators engineering centre 18 is connected to the medium 16 by any conventional connectivity medium such as, for example, a leased line. Once the cellular connections are made via the medium 16 data can flow bidirectionally to and from the aircraft.

FIGURE 2 is a block diagram illustrating a more detailed embodiment of system 10 illustrated in FIGURE 1, in accordance with an embodiment of the present invention. The aircraft 12 includes avionics system 55 having a suite (1 through N) of avionics (and electronic engine control) line replaceable units

(LRU). Each avionics and electronic engine control line replaceable unit includes a storage media for storing maintenance/diagnostics data in a digital format.

The maintenance/diagnostics data are transferred from the avionics and electronic engine control unit LRU 55 to the communications unit 26 via a bus 28. The bus 28 is connected to an avionics I/O interface 30 in the communications unit 26. The avionics I/O interface 30 can be a standard bus interface such as, for example, an ARINC 429 bus, RS-232/422 or Ethernet.

The avionics I/O interface 30 is connected to a GroundLink processor 32. The GroundLink processor 32 can be a general purpose processor such as a personal computer, a microprocessor such as an Intel Pentium.RTM processor, or a special purpose processor such as an application specific integrated circuit (ASIC) designed to operate in the system 10. The GroundLink processor is connected to one or more cellular channels 36 via multi port serial card 34.

The GroundLink processor 32 is responsive to an engine shut-off (or equivalent) signal, which notifies the GroundLink processor 32 to initiate transmission of the data after the aircraft 12 has landed. Upon receipt of this signal, the processor 32 acquires the maintenance/diagnostic data from the avionics LRU 55 via the avionics 1/O 30, and transmits the data to a multi-port serial card 34. Each 1/O port of the card 34 is attached to a cellular channel 36 which can open, sustain, and close a physical, over-the-air, channel to the cellular infrastructure 14. The cellular channels 36 can transmit and receive simultaneously and can thus transmit and receive data in parallel. Each cellular channel 36 is connected to an antenna matching network. One or more antennas 38 are installed in the aircraft 12 so as to optimise free space radiation to the cellular infrastructure 14.

The data are transmitted over cellular air link using the physical layer modulation of the cellular infrastructure 14. The cellular infrastructure 14 includes an antenna 40, which is within free-space radiating range of the aircraft 12. The antenna 40 is connected to a cellular base station transceiver subsystem 42. The subsystem 42 is connected to a cellular base station controller 44 which has a direct connection via a router (not shown) to the Internet 45. The data is transmitted via the Internet 45 to the airline/operators engineering centre 18.

A local router 46 in the airline/operators engineering centre 18 is connected to the Internet 45, such as via a connection to the backbone of the Internet 45. The router 46 connects a local area network 48 to the Internet 45. The local area network can be of any type of network such as, for example, a token ring network, an ATM network, or an Ethernet network. A GroundLink computer 50 is connected to the network 48 and receives the maintenance/diagnostics data from the specific aircraft tail number for storage in the attached storage unit 52 for analysis by related application programs. The storage unit 52 can be any type of unit capable of storing data such as, for example; disk drive or a disk array.

Data transfer can also occur from airline/operators engineering centre 18 to the aircraft 12. The data are transmitted over the Internet 45 and cellular infrastructure 14 and received by antenna 38. The serial card 34 receives the data from the cellular channels 38 and processor 32 outputs the data via the avionics I/O 30 to avionics 55 via bus 28.

FIGURE 3 is a block diagram illustrating data flow through the system 10 illustrated in FIGURE 2, in accordance with an embodiment of the present

invention. The maintenance data files are stored by the avionics LRUs. An application layer 58 of an operating system 60 of the GroundLink processor 32 acquires, compresses, encrypts, and segments the data files. The operating system 60 can be any type of operating system suitable such as, for example, UNIX. A typical stored file may be compressed from approximately 1 Mbytes to approximately 100 Kbytes. Compression may be done by any compression method such as, for example, the method embodied in the PKZIP.RTM. compression utility, manufactured by PKWARE, Inc. Encryption can be accomplished using any suitable asymmetric (public key) or symmetric encryption method such as, for example, the method embodied in Data Encryption Software (DES), manufactured by American Software Engineering or the methods in the RC2, RC4, or RC5 encryption software manufactured by RSA Data Security, Inc. During segmentation, individual datagrams of, for example, 1024 bytes are formed and indexed for subsequent reassemble.

The operating system 60 passes the datagrams to a network layer 62 which constructs UDP/IP packets from the datagrams by adding message headers to the datagrams. The network layer 62 then routes the packets to one of up to a fixed number (*e.g.*, 16) peer-to-peer protocol (PPP) threads running within the operating system 60 at a data link layer interface 64. The PPP convey the packets trough the multi port serial card 34 to the cellular channels 36. The packets are routed through the cellular infrastructure 14 to the Internet 45. The packets are received from the Internet 45 by the local router 46 in the airline/operators engineering centre 18. The network layer 62 receives acknowledgements of received packets from the GroundLink computer 50 in the airline/operators engineering centre 18. The network layer 62 also re-queues packets that are dropped before reaching the GroundLink computer 50.

The local router 46 in the airline/operators engineering centre 18 receives the packets and routes them to the GroundLink computer 50. A local network interface 68 receives the packets and a data link layer interface 70 of an operating system 72 passes the packets to a network layer 74 of the operating system 72. The operating system 72 can be any type of suitable operating system such as, for example Windows. The network layer 74 sends acknowledgements of successful packet deliveries to the GroundLink processor 32. The network layer 74 also removes the UPD/IP headers and passes the datagrams to an application layer 76. The application layer 76 reassembles, decrypts, and uncompresses the datagrams to restore the file to its original form. The application layer then passes the file 78 to the storage unit 52. The functions performed by the aircraft 12 and the airline/operator engineering centre 18 are similarly interchangeable when data is transferred from the airline/operator engineering centre 18 to the aircraft 12.

FIGURE 4 is a flowchart illustrating a method carried out by the GroundLink processor 32 in the aircraft, in accordance with an embodiment of the present invention. At step 81, the GroundLink processor 32 receives a "engine shut-off', or similar signal which indicates that data transmission process can be started and the GroundLink processor 32 initiates a data transfer by acquiring maintenance/diagnostics data files from avionics LRUs 55. At step 83, the application layer 58 compresses the acquired files and at step 84 it encrypts the file. At 86 the data is segmented into datagrams and UPD/IP packets are created and the packets are placed in a queue. The packets are ready for transmission over fixed number of threads, corresponding to the number of cellular channels 36. At step 89, the primary data thread is started to make the initial call and open the communications channel to the airline/operators engineering centre 18. There is a wait period, for example five seconds, inserted at step 91, and the status of the threads is tested for active

state at step 92. If any thread is found active the process loops back to the wait state. If there are no active channels detected at step 92 this method exits at step 93.

FIGURE 5 is a flowchart illustrating a method of performing the start primary data thread step 89 of FIGURE 4, in accordance with an embodiment of the present invention. At step 100 point to point (PPP) connection is initiated. At step 102 the process session is initiated. The secondary data threads are opened at step 103.

At step 104, it is determined if more packets are left to be transmitted. If so, the next packet in the data thread is transmitted at step 106 and the process loops back to step 104 to check if any more packet is available for transmission. If no packets are left to transmit, as determined at step 104, the state of the data threads is checked at step 108. If any data thread is found active at 108, then the process returns to step 104 to see if more data is to be transmitted. If it is found at step 108 that there is no active data thread then the session is ended at step 110. The PPP connections are closed at step 112 and the method exits at step 114.

FIGURE 6 is a flowchart illustrating a method of starting secondary data threads of step 103 of FIGURE 5, in accordance with an embodiment of the present invention. All the available secondary data threads are set active in step 118 by the data link interface 64. At step 120 the point to point (PPP) connections are initiated for each secondary data thread through the cellular channels 36 by the data link layer 64. At step 122 a test is made to determine if there are data packets for transmission. If packet is available, it is sent in step 124 to the GroundLink computer. If there is no more data packets to be sent, as

determined in step 122, the PPP connections are closed in step 126. The thread is set inactive in step 128 and the thread exits at step 130.

FIGURE 7 is a flowchart illustrating a method of operating the GroundLink computer 50 in the airline/operators engineering centre 18, in accordance with an embodiment of the present invention. In response to the call placed by the GroundLink processor 32 through the primary channel a socket is opened at step 132 by the operating system 72 in the computer 50 to receive messages transported across the Internet 45. At step 134, the computer 50 waits for a message from the Internet 45. When an initiate session message is received as determined at step 136, the application layer 76 allocates buffer space at step 138, sends a session acknowledgement message at step 140 to the GroundLink processor 32 on the aircraft 12 and the method returns to wait for additional messages at step 134. If the message received was a data packet, as determined at step 142, the network layer 74 removes the UDP/IP header and copies the datagram to the buffer in step 144. At step 146 the network layer 74 sends an acknowledge message to the GroundLink processor 32 on the aircraft 12.

If end session message is detected at step 148 the application layer 76 performs a process end session at step 152 and returns to wait for message step 134.

FIGURE 8 is a flowchart illustrating the steps included in the end session process step 152 of FIGURE 7, in accordance with an embodiment of the present invention. At step 160, the checksum is computed by the application layer 76 for the received data to check the integrity of the data. The checksum is checked at step 162 and if it is found to be correct the GroundLink computer 50 saves the buffer to a temporary file at step 164. The application

layer 76 of the GroundLink computer 50 then decrypts the file at step 166 and uncompresses the file at step 168. The uncompressed file 78 is stored at step 170 by the operating system 72 on storage unit 52. The GroundLink computer 50 sends an end session acknowledge message to the GroundLink processor 32 on aircraft 12 at step 174 and at step 178 the flow returns to step 134 of FIGURE 7. If the checksum is not correct, as determined at step 162, the GroundLink computer 50 sends an unsuccessful end session message (Nack) at step 176, which notifies the GroundLink processor 32 to re-send the data and the flow returns to step 134 of FIGURE 7.

FIGURE 9 is a block diagram illustrating another embodiment of the system 10 illustrated in FIGURE 1. The operation of the system 10 of FIGURE 9 is similar to that described in conjunction with the system 10 of FIGURE 2. However, the data that is transmitted by the GroundLink processor 32 via the cellular infrastructure 14 is routed by the public switched telephone network (PSTN) 210 to the modem bank 212. A modem bank 212 transmits the data to the GroundLink computer 50 via the local router 46 and local network 48. The modem bank 212 can have a modem dedicated to receive data from each one of the cellular channels 36.

In the present Specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

CLAIMS:

1. An aircraft maintenance and diagnostic data download system, comprising:

an aircraft having an avionics system and a communication unit, wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data, and wherein the communication unit is connected to the avionics and/or electronic engine control line replaceable units;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit, connected to the cellular infrastructure, wherein the data reception unit is remotely located from the aircraft, and wherein the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

2. The aircraft maintenance and diagnostic data download system of Claim 1, wherein said data reception unit is in communication with said cellular infrastructure via a computer network.

3. The aircraft maintenance and diagnostic data download system of Claim 2, wherein the computer network is the Internet.

4. The aircraft maintenance and diagnostic data download system of Claim 1, wherein said data reception unit is in communication with said cellular infrastructure via a telephone network.

5. The aircraft maintenance and diagnostic data download system of Claim 4, wherein the telephone network is a public switch telephone network.

6. The aircraft maintenance and diagnostic data download system of Claim 4, wherein the telephone network is an integrated services digital telephone network.

7. The aircraft maintenance and diagnostic data download system of any one of Claims 1 to 6, wherein said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

a multi-port serial card in communication with said processor;

a plurality of cell channels in communication with said multi-port serial card; and

one or more antennas in communication with said cell channels.

8. The aircraft maintenance and diagnostic data download system of any one of Claims 1 to 7, wherein said cellular infrastructure includes:

an antenna;

a transceiver subsystem in communication with said antenna; and

a controller in communication with said transceiver subsystem.

9. The aircraft maintenance and diagnostic data download system of any one of the preceding Claims 1, wherein said data reception unit includes:

a router; and

a processor in communication with said router, said processor having a storage unit.

10. An aircraft maintenance and diagnostic data download system, comprising:

an avionics system that comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data;

an avionics input/output interface that is connected each of the avionics and/or electronic engine control line replaceable units;

a processor that is connected to the avionics input/output interface;

a multi-port serial card that is connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit via a cellular infrastructure after the aircraft has landed, wherein the data reception unit is remotely located from the aircraft, and wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

11. An aircraft maintenance and diagnostic data download system of Claim 10, further comprising one or more antennas in communication with said cell channels.

12. An aircraft maintenance and diagnostic data download system of Claim 10 or 11, wherein the processor is a personal computer.

13. An aircraft maintenance and diagnostic data download system of Claim 10 or 11, wherein the processor is an application specific integrated circuit.

14. An aircraft maintenance and diagnostic data download system of Claim 10 or 11, wherein the processor is a microprocessor.

15. An aircraft, comprising:

an avionics system having a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable unit stores aircraft maintenance and diagnostic data; and

a communication unit, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and the communication unit is connected to one or more of the line replaceable units, and wherein the communication unit comprises:

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

16. An aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

means for transmitting aircraft maintenance and diagnostic data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft, and wherein the avionics system comprises a plurality of avionics and/or electronic engine control line replaceable units, wherein one or more avionics and/or electronic engine control line replaceable units stores the aircraft maintenance and diagnostic data; and

means for receiving said data from said cellular infrastructure.

17. An aircraft maintenance and diagnostic data download system of Claim 16, wherein said means for transmitting data includes a processor.

18. An aircraft maintenance and diagnostic data download system of Claim 16 or 17, wherein said means for receiving data includes a processor.

19. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

20. A method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units:

processing maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

21. The method of Claim 20, further comprising receiving said transmitted data at a flight operations centre.

22. The method of Claim 20, further comprising receiving said transmitted data at a flight operations centre via a computer network.

23. The method of Claim 20, further comprising receiving said transmitted data at a flight operations centre via a telephone network.

24. The method of any one of Claims 17 to 23, wherein processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

25. The method of Claim 20 or any Claims dependent thereon, wherein receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

reassembling said received data;

decrypting said reassembled data;

uncompressing said decrypted data; and

storing said uncompressed data.

26. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein processing said data includes;

receiving a signal which indicates that the data downloading process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

creating a packet queue;

staring a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

27. The method of Claim 26 wherein starting a primary data thread includes:

initiating a PPP connection;

initiating a transfer session;

starting at least one secondary data thread;

determining if data remains in the primary data thread;

sending said data when data remains in the primary data thread;

determining if data threads are active when no data remains in the primary data thread;

repeating, when said threads are active, the step of determining if data remains in the primary data thread;

ending said session when no threads are active;

closing said PPP connection; and

exiting starting a primary data thread.

28. The method of Claim 27 wherein starting at least one secondary data thread includes:

(a) setting the secondary data thread to active;

(b) initiating a PPP connection;

(c) determining if data remains in the secondary data thread;

(d) sending a data packet when data remains;

(e) repeating step c when data remains;

(f) closing said PPP connection when no data remains;

(g) setting the secondary data thread to inactive;

(h) exiting starting at least one secondary data thread; and

(i) repeating steps a through h for each secondary data thread.

29. The method of Claim 28, wherein repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

30. A computer-implemented method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed data via a cellular infrastructure after the aircraft has landed; and

receiving the downloaded maintenance and diagnostic data at a flight operations centre, wherein receiving said downloaded maintenance and diagnostic data includes;

creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is an end session; and repeating, when said message is not an end session message, the step of receiving a message.

31. The method of Claim 30 wherein initiating a session includes:

allocating buffer space;

sending an initiation [illegible] acknowledgement; and

returning to receiving a message.

32. The method of Claim 30 or 31, wherein processing said message when said message is a data message includes:

copying said message to a buffer;

sending a data message acknowledgement; and

returning to receiving a message.

33. The method of Claim 30, wherein processing said message when said message is not an end session includes:

computing a checksum;

determining if said checksum is valid;

saving a buffer to a temporary file;

decrypting said temporary file;

uncompressing said temporary file;

sending an end session acknowledgement; and

returning to receiving a message.

34. An article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of downloading maintenance and diagnostic data from an avionics systems located on an aircraft, the method comprising:

receiving maintenance and diagnostic data from a plurality of avionics and/or electronic engine [illegible]

processing said maintenance and diagnostic data to prepare said data for downloading; and

downloading said processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

35. An aircraft maintenance data system substantially as herein described with reference to and as shown in the accompanying drawings.

36. A method of transmitting maintenance and diagnostic data substantially as herein described with reference to and as shown in the accompanying drawings.

37. An aircraft substantially as herein described with reference to and as shown in the accompanying drawings.

5

38. An article of manufacture comprising a computer programme substantially as herein described with reference to and as shown in the accompanying drawings.

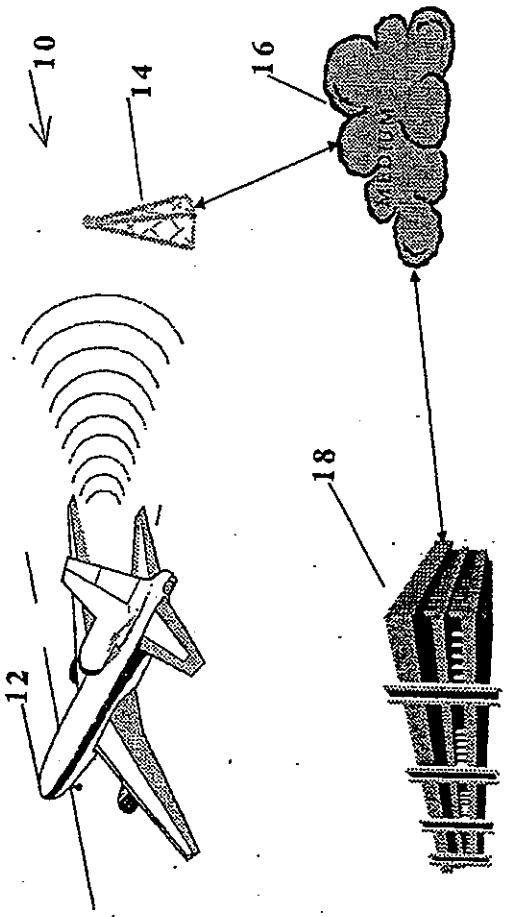


FIGURE 1

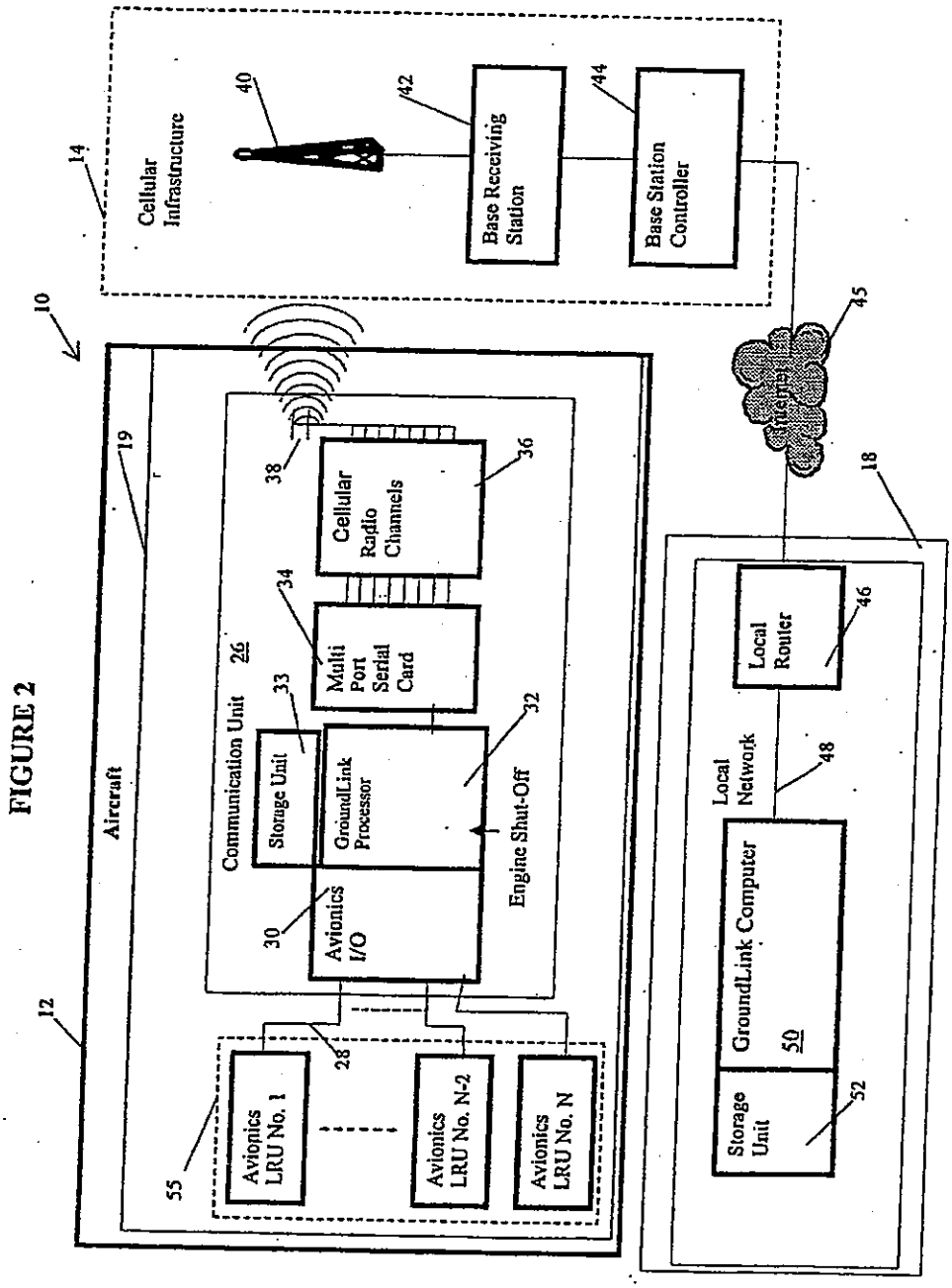
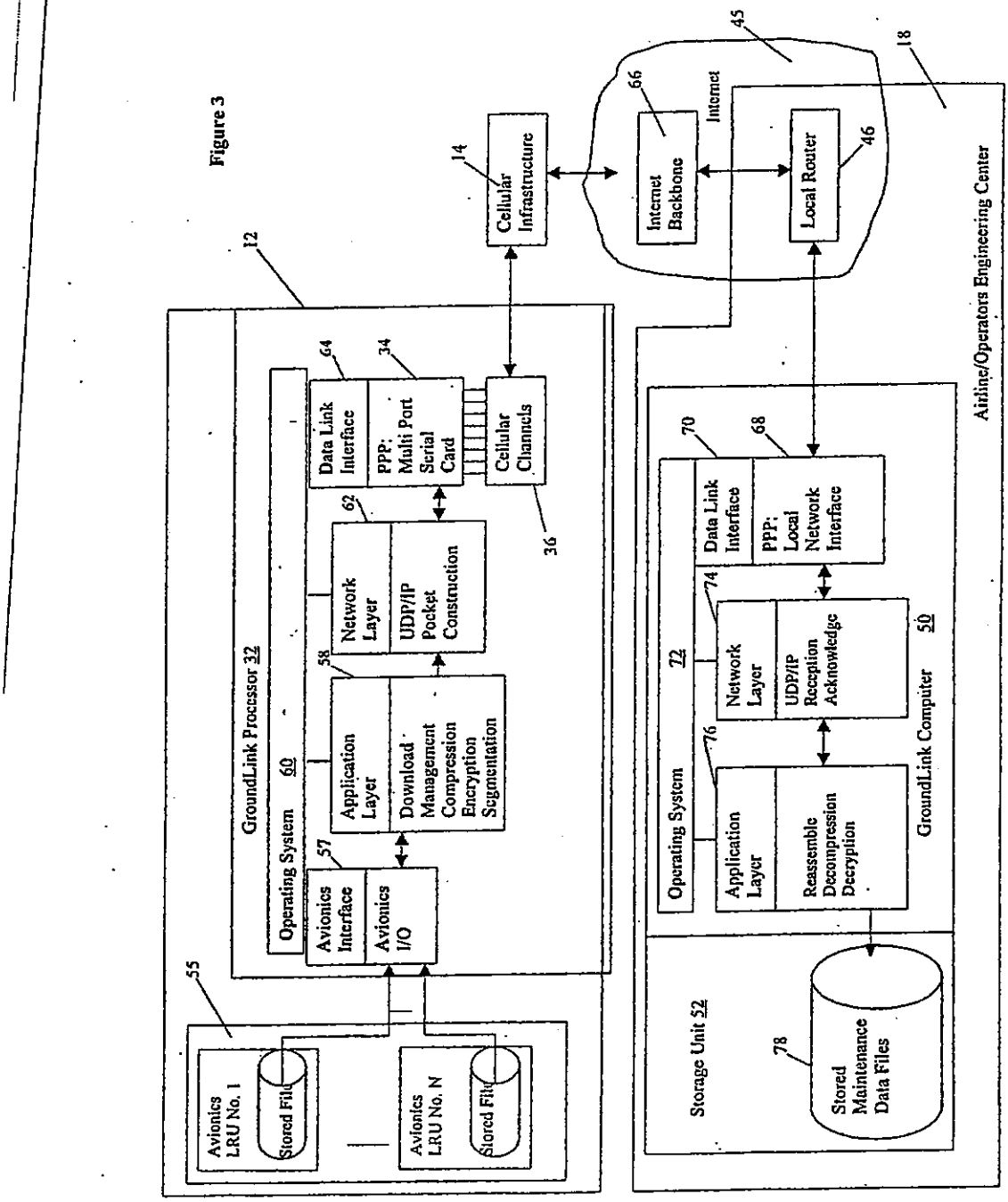

Cellular Infrastructure
14
40
42
Base Receiving Station
44
Base Station Controller
10
45
Internet
18
19
38
Cellular Radio Channels
36
34
Multi Port Serial Card
Communication Unit
26
33
Storage Unit
GroundLink Processor
32
Engine Shut-Off
30
Avionics I/O
Aircraft
12
28
55
Avionics LRU No. 1
Avionics LRU No. N-2
Avionics LRU No. N
Local Router
46
Local Network
48
GroundLink Computer
50
Storage Unit
52

FIGURE 2

Figure 3


Avionics LRU No. 1
Stored File
Avionics LRU No. N
Stored File
55
Avionics Interface
Avionics I/O
57
Operating System 60
GroundLink Processor 32
12
Application Layer
Download Management Compression Encryption Segmentation
58
Network Layer
UDP/IP Packet Construction
62
Data Link Interface
PPP: Multi Port Serial Card
64
34
Cellular Channels
36
Cellular Infrastructure
14
Internet Backbone
66
Internet
45
Local Router
46
18
Airline/Operators Engineering Center
Data Link Interface
PPP: Local Network Interface
70
68
Operating System
72
Network Layer
UDP/IP Reception Acknowledge
74
Application Layer
Reassemble Deconpression Decryption
76
GroundLink Computer 50
Storage Unit 52
Stored Maintenance Data Files
78

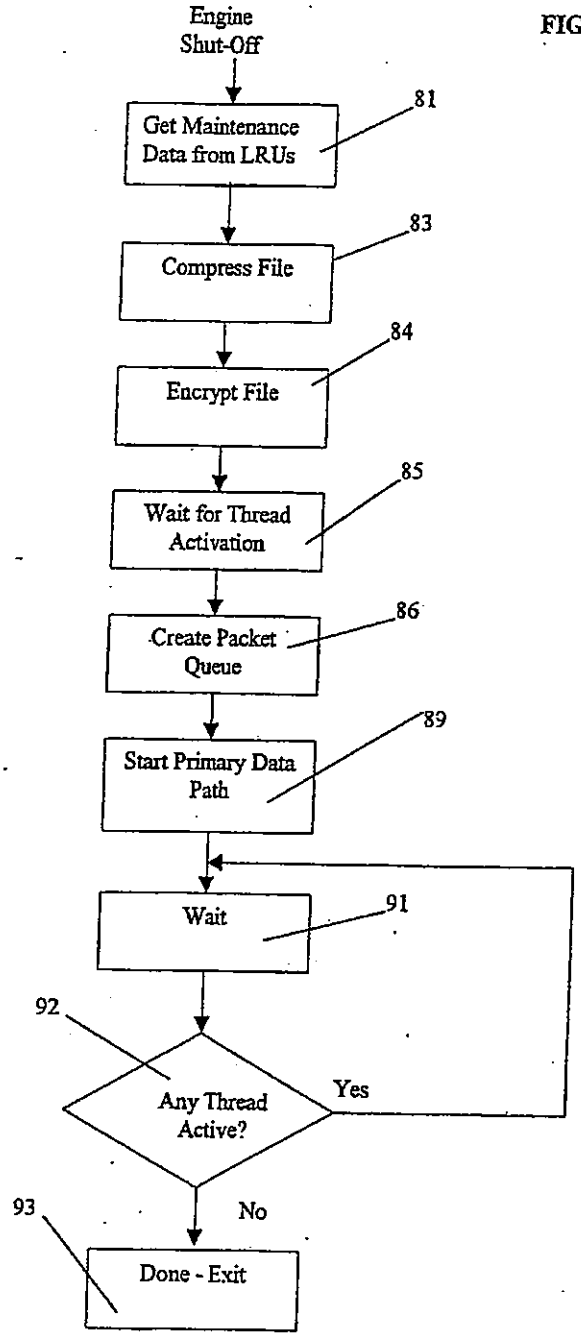

Engine Shut-Off
Get Maintenance Data from LRUs
81
Compress File
83
Encrypt File
84
Wait for Thread Activation
85
Create Packet Queue
86
Start Primary Data Path
89
Wait
91
92
Any Thread Active?
Yes
No
93
Done - Exit

FIGURE 4

FIGURE 5

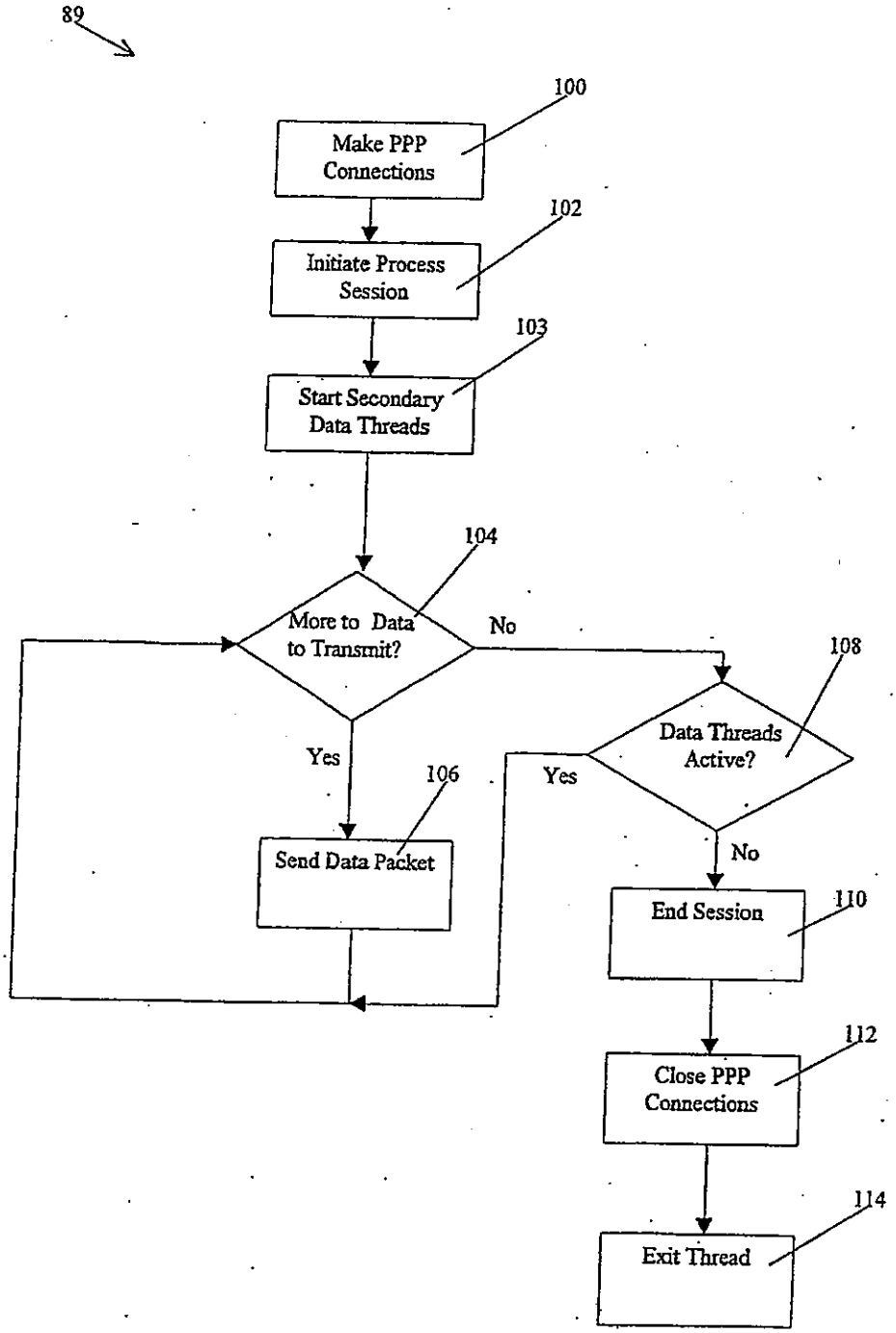

89
100
Make PPP Connections
102
Initiate Process Session
103
Start Secondary Data Threads
104
More to Data to Transmit?
No
Yes
106
Send Data Packet
108
Data Threads Active?
Yes
No
110
End Session
112
Close PPP Connections
114
Exit Thread

FIGURE 6

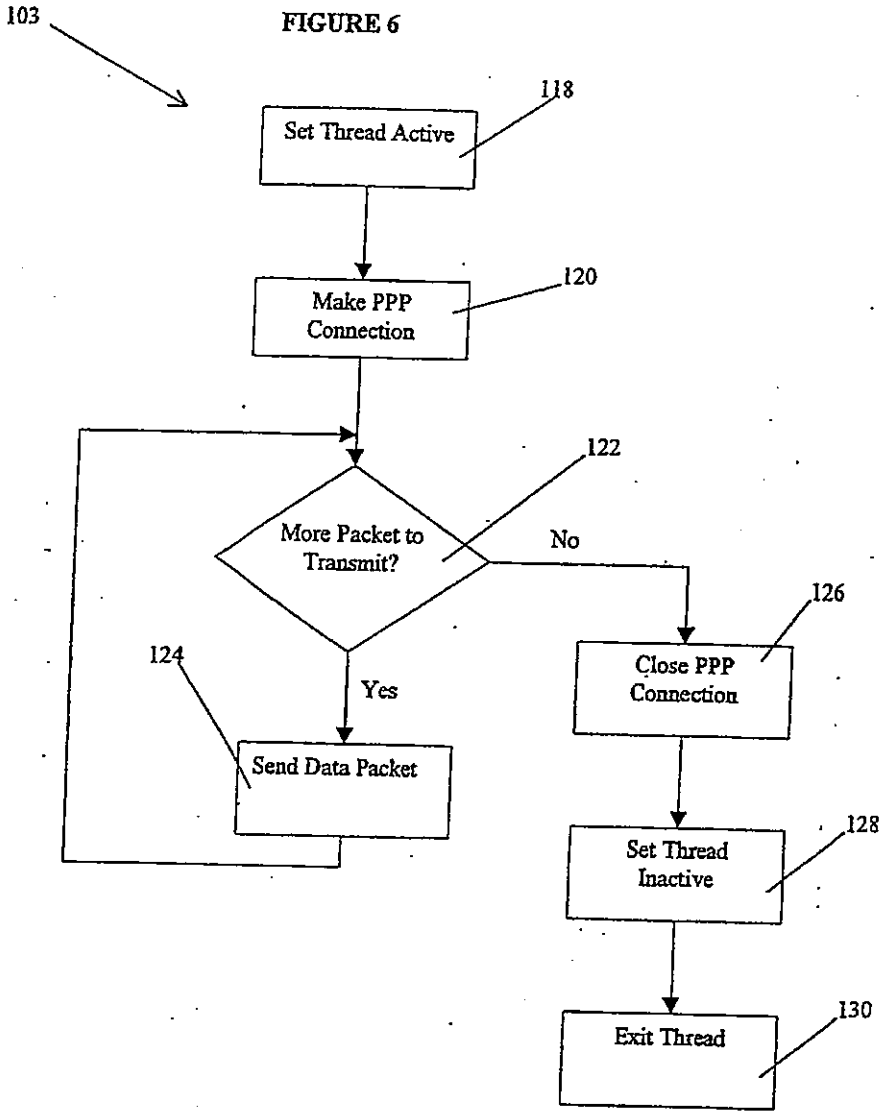

103
Set Thread Active
118
Make PPP Connection
120
More Packet to Transmit?
122
No
Yes
124
Send Data Packet
Close PPP Connection
126
Set Thread Inactive
128
Exit Thread
130

FIGURE 7

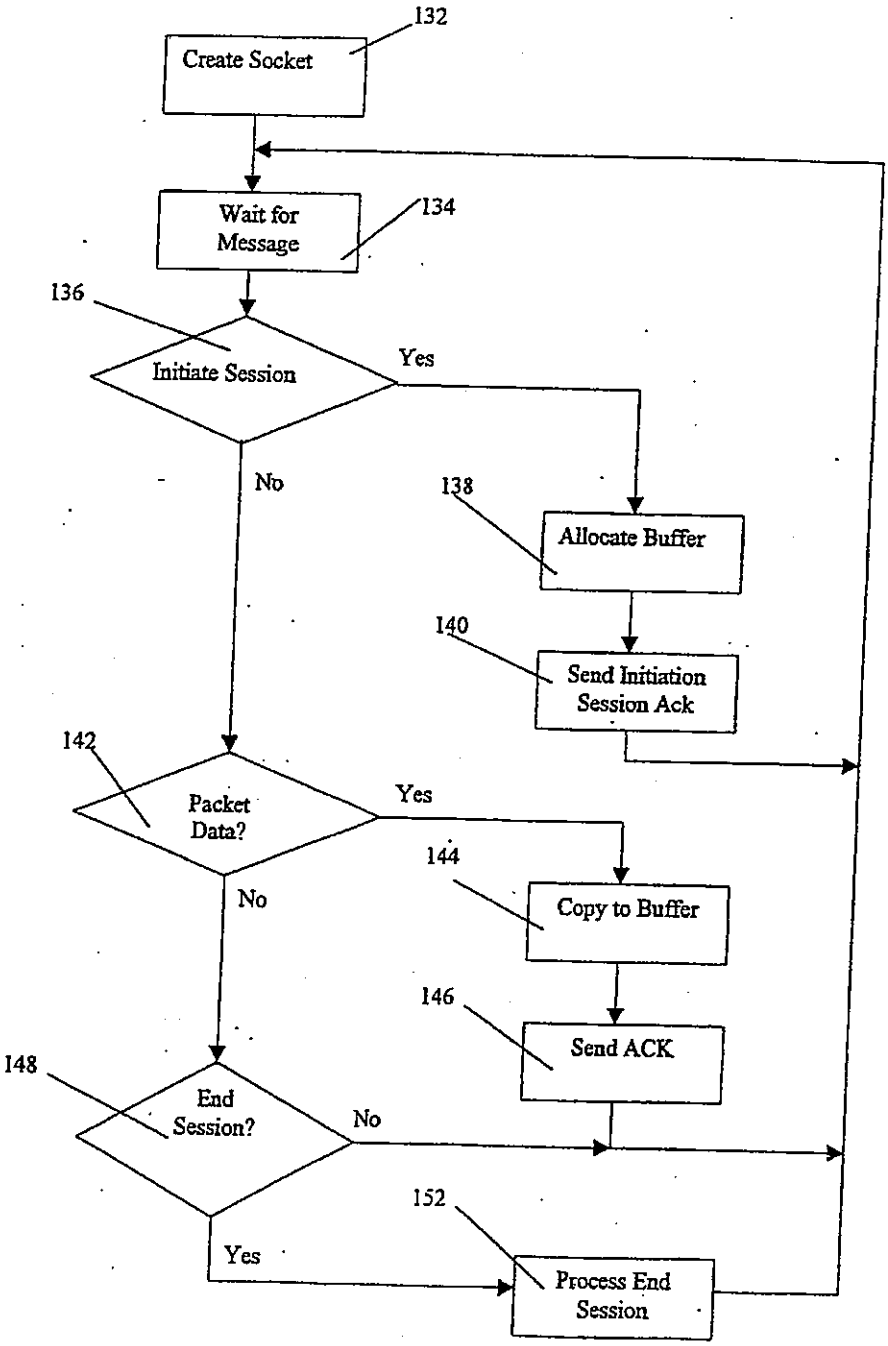
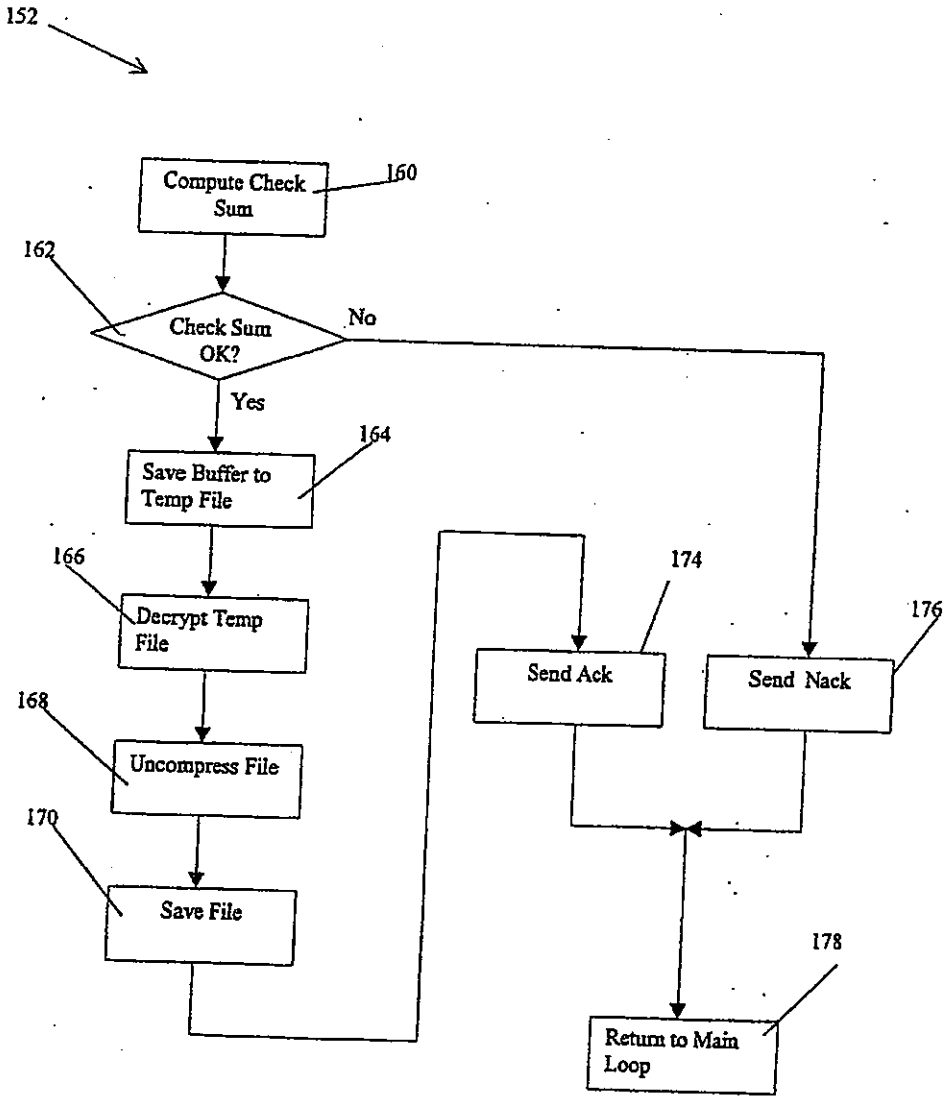

132
Create Socket
Wait for Message
134
136
Initiate Session
Yes
No
138
Allocate Buffer
140
Send Initiation Session Ack
142
Packet Data?
Yes
No
144
Copy to Buffer
146
Send ACK
148
End Session?
No
Yes
152
Process End Session

FIGURE 8


152
Compute Check Sum
160
162
Check Sum OK?
No
Yes
Save Buffer to Temp File
164
166
Decrypt Temp File
168
Uncompress File
170
Save File
174
Send Ack
176
Send Nack
178
Return to Main Loop

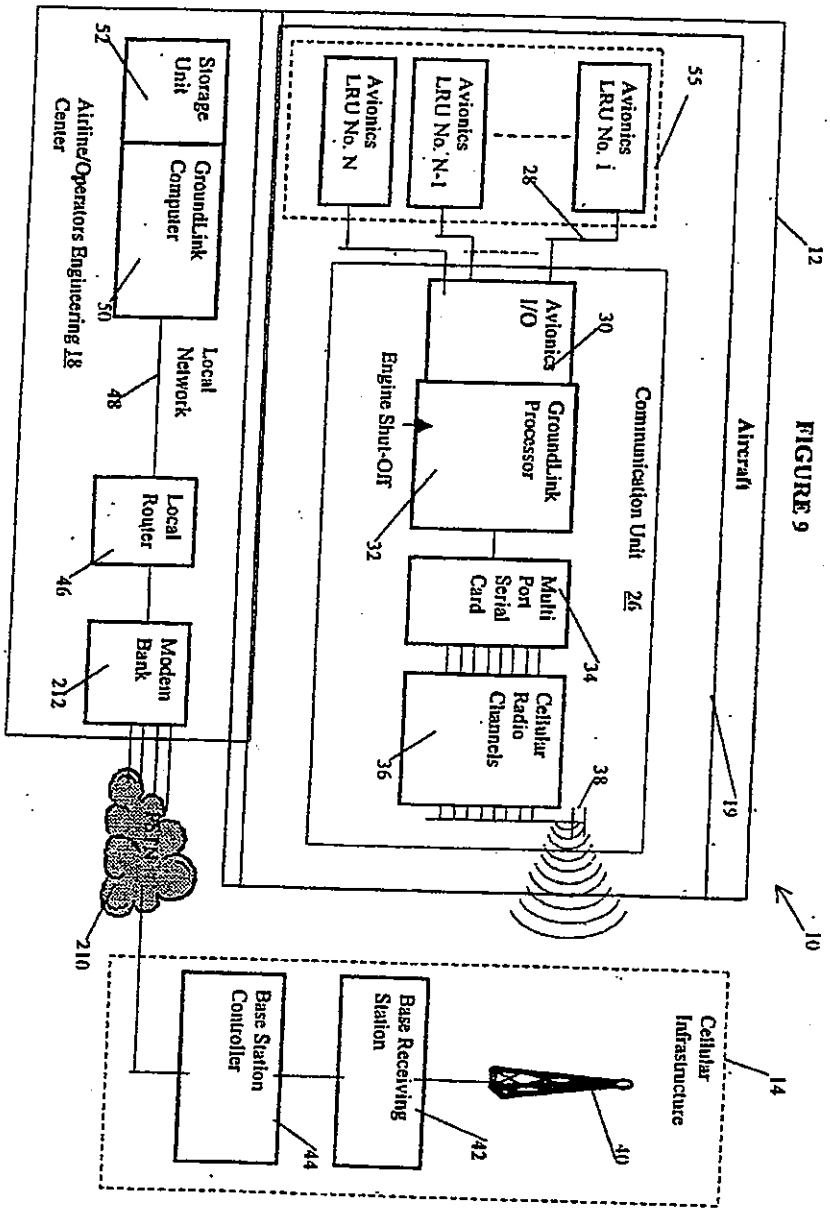

Airline/Operators Engineering 18
Storage Unit
52
GroundLink Computer
50
Local Network
48
Local Router
46
Modem Bank
212
210
Aircraft
12
Avionics LRU No. N
Avionics LRU No. N-1
Avionics LRU No. 1
55
28
Communication Unit 26
Avionics I/O
30
GroundLink Processor
Engine Shut-Off
32
Multi Port Serial Card
34
Cellular Radio Channels
36
38
19
10
Cellular Infrastructure
14
Base Station Controller
44
Base Receiving Station
42
40

FIGURE 9

C-(2)-9.5.06

The invention further relates to an aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and

means for receiving said data from said cellular infrastructure.

Conveniently said means for transmitting data includes a processor.

Preferably said means for receiving data includes a processor.

The invention also relates to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality avionics and/or electronic engine control line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

In a further embodiment the invention relates to a method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

16. An aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and

means for receiving said data from said cellular infrastructure.

17. An aircraft maintenance and diagnostic data download system of Claim 16, wherein said means for transmitting data includes a processor.

18. An aircraft maintenance and diagnostic data download system of Claim 16 or 17, wherein said means for receiving data includes a processor.

19. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality of avionics and/or electronic engine control line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

C - (20) - 16.1.05

Thus, there is a need for an aircraft maintenance/diagnostics download system that automatically transfers aircraft/engine and maintenance/diagnostic data to the airline's or operator's maintenance and engineering centre with little or no human involvement, and which relies on a widely available and reliable public wireless, public switch telephone network (PSTN), integrated services digital network (ISDN), and/or Internet delivery systems.

The present invention, which addresses this need, resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from an aircraft.

According to one aspect of this invention there is provided an aircraft maintenance and diagnostic data download system, comprising:

an aircraft having an avionics system and a communication unit, wherein the avionics system comprises a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data, and wherein the communications unit is connected to one or more line replaceable units;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit, connected to the cellular infrastructure, wherein the data reception unit is remotely located from the aircraft, and wherein the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

Preferably the line replaceable unit is an avionics line replaceable unit.

Conveniently the line replaceable unit is a an electronic engine control line replaceable unit.

Advantageously said data reception unit is in communication with said cellular infrastructure via a computer network.

Preferably the computer network is the Internet.

Conveniently said data reception unit is in communication with said cellular infrastructure via a telephone network.

Preferably the telephone network is a public switch telephone network.

Advantageously the telephone network is an integrated services digital telephone network.

Preferably said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

a multi-port serial card in communication with said processor;

a plurality of cell channels in communication with said multi-port serial card; and

one or more antennas in communication with said cell channels.

Conveniently said cellular infrastructure includes:

an antenna;

a transceiver subsystem in communication with said antenna; and

a controller in communication with said transceiver subsystem.

Advantageously said data reception unit includes:

a router; and

a processor in communication with said router, said processor having a storage unit.

According to another aspect of this invention there is provided an aircraft maintenance and diagnostic data download system, comprising:

an avionics system that comprises a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data;

an avionics input/output interface that is connected each of the line replaceable units;

a processor that is connected to the avionics input/output interface;

a multi-port serial card that is connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit via a cellular infrastructure after the aircraft has landed, wherein the data reception unit is remotely located from the aircraft, and wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

The system may further comprise one or more antennas in communication with said cell channels.

Advantageously the processor is a personal computer.

Alternatively the processor is an application specific integrated circuit.

Alternatively the processor is a microprocessor.

The invention also relates to an aircraft, comprising:

an avionics system having a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data; and

a communication unit, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and the communication unit is connected to one or more of the line replaceable units, and wherein the communication unit comprises:

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

The invention further relates to an aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and

means for receiving said data from said cellular infrastructure.

Conveniently said means for transmitting data includes a processor.

Preferably said means for receiving data includes a processor.

The invention also relates to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

In a further embodiment the invention relates to a method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

The method may further comprise receiving said transmitted data at a flight operations centre.

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a computer network.

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a telephone network.

Preferably processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

Conveniently receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

reassembling said received data;

decrypting said reassembled data;

uncompressing said decrypted data; and

storing said uncompressed data.

The invention may be considered to relate to a method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein processing said data includes;

receiving a signal which indicates that the data downloading process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

creating a packet queue;

staring a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

Advantageously repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

The invention also relates to a computer-implemented method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed data via a cellular infrastructure after the aircraft has landed; and

receiving the downloaded maintenance and diagnostic data at a flight operations centre, wherein receiving said downloaded maintenance and diagnostic data includes;

creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is an end session; and repeating, when said message is not an end session message, the step of receiving a message.

receiving maintenance and diagnostic data from a plurality of line replaceable units;

processing said maintenance and diagnostic data to prepare said data for downloading; and

downloading said processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

The system comprises an aircraft, a cellular infrastructures and a data reception unit. The aircraft has an avionics system and a communications unit. The avionics system comprises a plurality of line replaceable units. The communications unit is connected to each line replaceable unit. The cellular infrastructure is in communication with said communications unit after the aircraft has landed. The communication is initiated automatically upon the landing of the aircraft. The data reception unit is connected to the cellular infrastructure.

CLAIMS:

1. An aircraft maintenance and diagnostic data download system, comprising:

an aircraft having an avionics system and a communication unit, wherein the avionics system comprises a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data, and wherein the communications unit is connected to one or more line replaceable units;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit, connected to the cellular infrastructure, wherein the data reception unit is remotely located from the aircraft, and wherein the data reception unit receives the aircraft maintenance and diagnostic data from the communications unit.

2. The aircraft maintenance and diagnostic data download system of Claim 1, wherein the line replaceable unit is an avionics line replaceable unit.

3. The aircraft maintenance and diagnostic data download system of Claim 1, wherein the line replaceable unit is an electronic engine control line replaceable unit.

4. The aircraft maintenance and diagnostic data download system of Claim 1, 2 or 3, wherein said data reception unit is in communication with said cellular infrastructure via a computer network.

5. The aircraft maintenance and diagnostic data download system of Claim 4, wherein the computer network is the Internet.

6. The aircraft maintenance and diagnostic data download system of Claim 1, 2 or 3, wherein said data reception unit is in communication with said cellular infrastructure via a telephone network.

7. The aircraft maintenance and diagnostic data download system of Claim 6, wherein the telephone network is a public switch telephone network.

8. The aircraft maintenance and diagnostic data download system of Claim 6, wherein the telephone network is an integrated services digital telephone network.

9. The aircraft maintenance and diagnostic data download system of any one of Claims 1 to 8, wherein said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

a multi-port serial card in communication with said processor;

a plurality of cell channels in communication with said multi-port serial card; and

one or more antennas in communication with said cell channels.

10. The aircraft maintenance and diagnostic data download system of any one of Claims 1 to 9, wherein said cellular infrastructure includes:

an antenna;

a transceiver subsystem in communication with said antenna; and

a controller in communication with said transceiver subsystem.

11. The aircraft maintenance and diagnostic data download system of any one of the preceding Claims 1, wherein said data reception unit includes:

a router; and

a processor in communication with said router, said processor having a storage unit.

12. An aircraft maintenance and diagnostic data download system, comprising:

an avionics system that comprises a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data;

an avionics input/output interface that is connected each of the line replaceable units;

a processor that is connected to the avionics input/output interface;

a multi-port serial card that is connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a data reception unit via a cellular infrastructure after the aircraft has landed, wherein the data reception unit is remotely located from the aircraft, and wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

13. An aircraft maintenance and diagnostic data download system of Claim 12, further comprising one or more antennas in communication with said cell channels.

14. An aircraft maintenance and diagnostic data download system of Claim 12 13, wherein the processor is a personal computer.

15. An aircraft maintenance and diagnostic data download system of Claim 12 or 13, wherein the processor is an application specific integrated circuit.

16. An aircraft maintenance and diagnostic data download system of Claim 12 or 13, wherein the processor is a microprocessor.

17. An aircraft, comprising:

an avionics system having a plurality of line replaceable units, wherein one or more line replaceable unit stores aircraft maintenance and diagnostic data; and

a communication unit, wherein the communications unit is used for downloading the aircraft maintenance and diagnostic data, and the communication unit is connected to one or more of the line replaceable units, and wherein the communication unit comprises:

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for downloading aircraft maintenance and diagnostic data to a

data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

18. An aircraft maintenance and diagnostic data download system, the aircraft having an avionics system, comprising:

means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and

means for receiving said data from said cellular infrastructure.

19. An aircraft maintenance and diagnostic data download system of Claim 18, wherein said means for transmitting data includes a processor.

20. An aircraft maintenance and diagnostic data download system of Claim 18 or 19, wherein said means for receiving data includes a processor.

21. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality line replaceable units;

downloading the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the downloaded maintenance and diagnostic data, wherein the data reception unit is remotely located from the aircraft.

22. A method of downloading maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

23. The method of Claim 22, further comprising receiving said transmitted data at a flight operations centre.

24. The method of Claim 22, further comprising receiving said transmitted data at a flight operations centre via a computer network.

25. The method of Claim 22, further comprising receiving said transmitted data at a flight operations centre via a telephone network.

26. The method of any one of Claims 19 to 26, wherein processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

27. The method of Claim 22 or any Claims dependent thereon, wherein receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

reassembling said received data;

decrypting said reassembled data;

uncompressing said decrypted data; and

storing said uncompressed data.

28. A method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure after the aircraft has landed, wherein processing said data includes;

receiving a signal which indicates that the data downloading process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

creating a packet queue;

staring a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

29. The method of Claim 28 wherein starting a primary data thread includes:

initiating a PPP connection;

initiating a transfer session;

starting at least one secondary data thread;

determining if data remains in the primary data thread;

sending said data when data remains in the primary data thread;

determining if data threads are active when no data remains in the primary data thread;

repeating, when said threads are active, the step of determining if data remains in the primary data thread;

ending said session when no threads are active;

closing said PPP connection; and

exiting starting a primary data thread.

30. The method of Claim 29 wherein starting at least one secondary data thread includes:

(a) setting the secondary data thread to active;

(b) initiating a PPP connection;

(c) determining if data remains in the secondary data thread;

(d) sending a data packet when data remains;

(e) repeating step c when data remains;

(f) closing said PPP connection when no data remains;

(g) setting the secondary data thread to inactive;

(h) exiting starting at least one secondary data thread; and

(i) repeating steps a through h for each secondary data thread.

31. The method of Claim 30, wherein repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

32. A computer-implemented method of downloading maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

downloading the processed data via a cellular infrastructure after the aircraft has landed; and

receiving the downloaded maintenance and diagnostic data at a flight operations centre, wherein receiving said downloaded maintenance and diagnostic data includes;

creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is an end session; and repeating, when said message is not an end session message, the step of receiving a message.

33. The method of Claim 32 wherein initiating a session includes:

allocating buffer space;

sending an initiation session acknowledgement; and

returning to receiving a message.

34. The method of Claim 32 or 33, wherein processing said message when said message is a data message includes:

copying said message to a buffer;

sending a data message acknowledgement; and

returning to receiving a message.

35. The method of Claim 32, wherein processing said message when said message is not an end session includes:

computing a checksum;

determining if said checksum is valid;

saving a buffer to a temporary file;

decrypting said temporary file;

uncompressing said temporary file;

sending an end session acknowledgement; and

returning to receiving a message.

36. An article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of downloading maintenance and diagnostic data from an avionics systems located on an aircraft, the method comprising:

receiving maintenance and diagnostic data from a plurality of line replaceable units;

processing said maintenance and diagnostic data to prepare said data for downloading; and

downloading said processed maintenance and diagnostic data to a data reception unit that is remotely located from the aircraft via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

37. An aircraft maintenance data system substantially as herein described with reference to and as shown in the accompanying drawings.

38. A method of transmitting maintenance and diagnostic data substantially as herein described with reference to and as shown in the accompanying drawings.

39. An aircraft substantially as herein described with reference to and as shown in the accompanying drawings.

40. An article of manufacture comprising a computer programme substantially as herein described with reference to and as shown in the accompanying drawings.

C. 30/9/05

(21)

data to the airline's or operator's maintenance and engineering centre with little or no human involvement, and which relies on a widely available and reliable public wireless, public switch telephone network (PSTN), integrated services digital network (ISDN), and/or Internet delivery systems.

The present invention, which addresses this need, resides in a system, method and an article of manufacture for transmitting maintenance and diagnostic data from an aircraft.

According to one aspect of this invention there is provided an aircraft maintenance data transmission system, comprising:

an aircraft having an avionics system and a communications unit, wherein the avionics system comprises a plurality of line replaceable units, and wherein the communications unit is connected to each line replaceable;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit connected to the cellular infrastructure.

Preferably the line replaceable unit is an avionics line replaceable unit.

Conveniently the line replaceable unit is a an electronic engine control line replaceable unit.

Advantageously said data reception unit is in communication with said cellular infrastructure via a computer network.

Preferably the computer network is the Internet.

Conveniently said data reception unit is in communication with said cellular infrastructure via a telephone network.

Preferably the telephone network is a public switch telephone network.

Advantageously the telephone network is an integrated services digital telephone network.

Preferably said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

a multi-port serial card in communication with said processor;

a plurality of cell channels in communication with said multi-port serial card; and

one or more antennas in communication with said cell channels.

Conveniently said cellular infrastructure includes:

an antenna;

a transceiver subsystem in communication with said antenna; and

a controller in communication with said transceiver subsystem.

Advantageously said data reception unit includes:

a router; and

a processor in communication with said router, said processor having a storage unit.

According to another aspect of this invention there is provided an aircraft maintenance data system, comprising:

an avionics system that comprises a plurality of line replaceable units;

an avionics input/output interface that is connected each of the line replaceable units;

a processor that is connected to the avionics input/output interface;

a multi-port serial card that is connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for transmitting data via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

The system may further comprise one or more antennas in communication with said cell channels.

Advantageously the processor is a personal computer.

Alternatively the processor is an application specific integrated circuit.

Alternatively the processor is a microprocessor.

The invention also relates to an aircraft, comprising:

an avionics system having a plurality of line replaceable units; and

a communications unit connected to each of the line replaceable units, comprising:

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for transmitting data via a cellular infrastructure after the aircraft

has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

The invention further relates to an aircraft data transmission system, the aircraft having an avionics system, comprising:

means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and

means for receiving said data from said cellular infrastructure.

Conveniently said means for transmitting data includes a processor.

Preferably said means for receiving data includes a processor.

The invention also relates to a method of transmitting maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality line replaceable units;

transmitting the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the transmitted maintenance and diagnostic data.

In a further embodiment the invention relates to a method of transmitting maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing maintenance and diagnostic data; and

transmitting the processed maintenance and diagnostic data via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

The method may further comprise receiving said transmitted data at a flight operations centre.

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a computer network.

Alternatively the method may further comprise receiving said transmitted data at a flight operations centre via a telephone network.

Preferably processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

Conveniently receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

reassembling said received data;

decrypting said reassembled data;

uncompressing said decrypted data; and

storing said uncompressed data.

The invention may be considered to relate to a method of transmitting maintenance and diagnostic data from an aircraft, comprising:

receiving data from a plurality of line replaceable units;

processing the data; and

transmitting the processed data via a cellular infrastructure after the aircraft has landed, wherein processing said data includes:

receiving a signal which indicates that the data transmission process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

creating a packet queue;

starting a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

Preferably starting a primary data thread includes:

initiating a PPP connection;

initiating a transfer session;

starting at least one secondary data thread;

determining if data remains in the primary data thread;

sending said data when data remains in the primary data thread;

determining if data threads are active when no data remains in the primary data thread;

repeating, when said threads are active, the step of determining if data remains in the primary data thread;

ending said session when no threads are active;

closing said PPP connection; and

exiting starting a primary data thread.

Conveniently starting at least one secondary data thread includes:

(a) setting the secondary data thread to active;

(b) initiating a PPP connection;

(c) determining if data remains in the secondary data thread;

(d) sending a data packet when data remains;

(e) repeating step c when data remains;

(f) closing said PPP connection when no data remains;

(g) setting the secondary data thread to inactive;

(h) exiting starting at least one secondary data thread; and

(i) repeating steps a through h for each secondary data thread.

Advantageously repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

The invention also relates to a computer-implemented method of transmitting maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

transmitting the processed data via a cellular infrastructure after the aircraft has landed; and

receiving the transmitted data at a flight operations centre, wherein receiving said transmitted data includes:

creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is an end session; and

repeating, when said message is not an end session message, the step of receiving a message.

Preferably initiating a session includes:

allocating buffer space;

sending an initiation session acknowledgement; and

returning to receiving a message.

Advantageously processing said message when said message is a data message includes:

copying said message to a buffer;

sending a data message acknowledgement; and

returning to receiving a message.

Preferably processing said message when said message is not an end session includes:

computing a checksum;

determining if said checksum is valid;

saving a buffer to a temporary file;

decrypting said temporary file;

uncompressing said temporary file;

sending an end session acknowledgement; and

returning to receiving a message.

The invention also relates to an article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of transmitting maintenance and diagnostic data from an avionics system located on an aircraft, the method comprising:

receiving maintenance and diagnostic data from a plurality of line replaceable units;

processing said maintenance and diagnostic data to prepare said data for transmission; and

transmitting said processed data via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

The system comprises an aircraft, a cellular infrastructures and a data reception unit. The aircraft has an avionics system and a communications unit. The avionics system comprises a plurality of line replaceable units. The communications unit is connected to each line replaceable unit. The cellular infrastructure is in communication with said communications unit after the aircraft has landed. The communication is initiated automatically upon the landing of the aircraft. The data reception unit is connected to the cellular infrastructure.

layer 76 of the GroundLink computer 50 then decrypts the file at step 166 and uncompresses the file at step 168. The uncompressed file 78 is stored at step 170 by the operating system 72 on storage unit 52. The GroundLink computer 50 sends an end session acknowledge message to the GroundLink processor 32 on aircraft 12 at step 174 and at step 178 the flow returns to step 134 of FIGURE 7. If the checksum is not correct, as determined at step 162, the GroundLink computer 50 sends an unsuccessful end session message (Nack) at step 176, which notifies the GroundLink processor 32 to re-send the data and the flow returns to step 134 of FIGURE 7.

FIGURE 9 is a block diagram illustrating another embodiment of the system 10 illustrated in FIGURE 1. The operation of the system 10 of FIGURE 9 is similar to that described in conjunction with the system 10 of FIGURE 2. However, the data that is transmitted by the GroundLink processor 32 via the cellular infrastructure 14 is routed by the public switched telephone network (PSTN) 210 to the modem bank 212. A modem bank 212 transmits the data to the GroundLink computer 50 via the local router 46 and local network 48. The modem bank 212 can have a modem dedicated to receive data from each one of the cellular channels 36.

While the present invention has been described in conjunction with preferred embodiments thereof, many modifications and variations will be apparent to those of ordinary skill in the art. For example, although the system has been described hereinabove as transferring data from the aircraft, the system can also be used to transfer data to the aircraft with no modifications in the system. Also, the system may be used to transmit data while the aircraft is in flight. Furthermore, the system may be used without encryption and without data compression prior to sending data. The foregoing description and the following claims are intended to cover all such modifications and variations.

In the present Specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following Claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. An aircraft maintenance data transmission system, comprising:

an aircraft having an avionics system and a communications unit, wherein the avionics system comprises a plurality of line replaceable units, and wherein the communications unit is connected to each line replaceable;

a cellular infrastructure in communication with said communications unit after the aircraft has landed, wherein the communication is initiated automatically upon the landing of the aircraft; and

a data reception unit connected to the cellular infrastructure.

2. The aircraft maintenance data transmission system of claim 1, wherein the line replaceable unit is an avionics line replaceable unit.

3. The aircraft maintenance data transmission system of claim 1, wherein the line replaceable unit is a an electronic engine control line replaceable unit.

4. The aircraft maintenance data transmission system of claim 1, 2 or 3, wherein said data reception unit is in communication with said cellular infrastructure via a computer network.

5. The aircraft maintenance data transmission system of claim 4, wherein the computer network is the Internet.

6. The aircraft maintenance data transmission system of claim 1, 2 or 3, wherein said data reception unit is in communication with said cellular infrastructure via a telephone network.

7. The aircraft maintenance data transmission system of claim 6, wherein the telephone network is a public switch telephone network.

8. The aircraft maintenance data transmission system of claim 6, wherein the telephone network is an integrated services digital telephone network.

9. The aircraft maintenance data transmission system of any one of claims 1 to 8, wherein said communications unit includes:

an avionics input/output interface;

a processor that is connected to the avionics input/output interface;

a multi-port serial card in communication with said processor;

a plurality of cell channels in communication with said multi-port serial card; and

one or more antennas in communication with said cell channels.

10. The aircraft maintenance data transmission system of any one of claims 1 to 9, wherein said cellular infrastructure includes:

an antenna;

a transceiver subsystem in communication with said antenna; and

a controller in communication with said transceiver subsystem.

11. The aircraft maintenance data transmission system of any one of the preceding claims, wherein said data reception unit includes:

a router; and

a processor in communication with said router, said processor having a storage unit.

12. An aircraft maintenance data system, comprising:

an avionics system that comprises a plurality of line replaceable units;

an avionics input/output interface that is connected each of the line replaceable units;

a processor that is connected to the avionics input/output interface;

a multi-port serial card that is connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for transmitting data via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

13. The aircraft maintenance data system of claim 12, further comprising one or more antennas in communication with said cell channels.

14. The aircraft maintenance data system of claim 12 or 13, wherein the processor is a personal computer.

15. The aircraft maintenance data system of claim 12 or 13, wherein the processor is an application specific integrated circuit.

16. The aircraft maintenance data system of claim 12 or 13, wherein the processor is a microprocessor.

17. An aircraft, comprising:

an avionics system having a plurality of line replaceable units; and

a communications unit connected to each of the line replaceable units, comprising:

an avionics input/output interface;

a processor connected to the avionics input/output interface;

a multi-port serial card connected to the processor; and

a plurality of cell channels connected to the multi port serial card, said cell channels for transmitting data via a cellular infrastructure after the aircraft has landed, wherein the communication between the cell channels and the multi port serial card is automatically initiated upon the landing of the aircraft.

18. An aircraft data transmission system, the aircraft having an avionics system, comprising:

means for transmitting data from the avionics system via a cellular infrastructure after the aircraft has landed, wherein the transmission of the data is initiated automatically upon landing of the aircraft; and

means for receiving said data from said cellular infrastructure.

19. The aircraft data transmission system of claim 18, wherein said means for transmitting data includes a processor.

20. The aircraft data transmission system of claim 18 or 19, wherein said means for receiving data includes a processor.

21. A method of transmitting maintenance and diagnostic data from an aircraft, comprising:

at the aircraft;

receiving the maintenance and diagnostic data from a plurality line replaceable units;

transmitting the maintenance and diagnostic data via a cellular communications infrastructure after the aircraft has landed, wherein the cellular communications infrastructure is accessed automatically upon landing of the aircraft; and

at a data reception unit, receiving the transmitted maintenance and diagnostic data.

22. A method of transmitting maintenance and diagnostic data from an avionics system located on an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing maintenance and diagnostic data; and

transmitting the processed maintenance and diagnostic data via a cellular infrastructure after the aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

23. The method of claim 22, further comprising receiving said transmitted data at a flight operations centre.

24. The method of claim 22, further comprising receiving said transmitted data at a flight operations centre via a computer network.

25. The method of claim 22, further comprising receiving said transmitted data at a flight operations centre via a telephone network.

26. The method of any one of claims 19 to 26, wherein processing said data includes:

compressing the data;

encrypting the data;

segmenting the data; and

constructing packets of data from said segmented data.

27. The method of claim 22 or any claims dependent thereon, wherein receiving said transmitted data includes:

acknowledging receipt of said transmitted data;

reassembling said received data;

decrypting said reassembled data;

uncompressing said decrypted data; and

storing said uncompressed data.

28. A method of transmitting maintenance and diagnostic data from an aircraft, comprising:

receiving data from a plurality of line replaceable units;

processing the data; and

transmitting the processed data via a cellular infrastructure after the aircraft has landed, wherein processing said data includes:

receiving a signal which indicates that the data transmission process can begin;

initiating a data transfer;

compressing said data;

encrypting said compressed data;

creating a packet queue;

starting a primary data thread;

waiting a predetermined period of time;

determining if any threads are active;

repeating, when threads are active, the steps of waiting a predetermined period of time and determining if any threads are active; and

exiting processing said data when no threads are active.

29. The method of claim 28 wherein starting a primary data thread includes:

initiating a PPP connection;

initiating a transfer session;

starting at least one secondary data thread;

determining if data remains in the primary data thread;

sending said data when data remains in the primary data thread;

determining if data threads are active when no data remains in the primary data thread;

repeating, when said threads are active, the step of determining if data remains in the primary data thread;

ending said session when no threads are active;

closing said PPP connection; and

exiting starting a primary data thread.

30. The method of claim 29 wherein starting at least one secondary data thread includes:

(a) setting the secondary data thread to active;

(b) initiating a PPP connection;

(c) determining if data remains in the secondary data thread;

(d) sending a data packet when data remains;

(e) repeating step c when data remains;

(f) closing said PPP connection when no data remains;

(g) setting the secondary data thread to inactive;

(h) exiting starting at least one secondary data thread; and

(i) repeating steps a through h for each secondary data thread.

31. The method of claim 30, wherein repeating steps a through h includes repeating steps a through h in parallel for each said secondary data thread.

32. A computer-implemented method of transmitting maintenance and diagnostic data from an aircraft, comprising:

receiving the maintenance and diagnostic data from a plurality of line replaceable units;

processing the maintenance and diagnostic data; and

transmitting the processed data via a cellular infrastructure after the aircraft

has landed; and

receiving the transmitted data at a flight operations centre, wherein receiving said transmitted data includes:

creating a socket;

receiving a message;

determining if said message is an initialisation message;

initiating a session when said message is an initialisation message;

determining if said message is a data message when said message is not an initialisation message;

processing said message when said message is a data message;

determining if said message is an end session when said message is not a data message;

processing said message when said message is an end session; and

repeating, when said message is not an end session message, the step of receiving a message.

33. The method of claim 32 wherein initiating a session includes:

allocating buffer space;

sending an initiation session acknowledgement; and

returning to receiving a message.

34. The method of claim 32 or 33, wherein processing said message when said message is a data message includes:

copying said message to a buffer;

sending a data message acknowledgement; and

returning to receiving a message.

35. The method of claim 32, wherein processing said message when said message is not an end session includes:

computing a checksum;

determining if said checksum is valid;

saving a buffer to a temporary file;

decrypting said temporary file;

uncompressing said temporary file;

sending an end session acknowledgement; and

returning to receiving a message.

36. An article of manufacture comprising a computer program carrier, readable by a processor and embodying one or more instructions executable by the processor to perform the method of transmitting maintenance and diagnostic data from an avionics system located on an aircraft, the method comprising:

receiving maintenance and diagnostic data from a plurality of line replaceable units;

processing said maintenance and diagnostic data to prepare said data for transmission; and

transmitting said processed data via a cellular infrastructure when said aircraft has landed, wherein the cellular infrastructure is accessed automatically upon landing of the aircraft.

37. An aircraft maintenance data transmission system substantially as herein described with reference to and as shown in the accompanying drawings.

39. A method of transmitting maintenance and diagnostic data substantially as herein described with reference to and as shown in the accompanying drawings.

39. An aircraft substantially as herein described with reference to and as shown in the accompanying drawings.

40. An article of manufacture comprising a computer programme substantially as herein described with reference to and as shown in the accompanying drawings.

41. Any novel feature or combination of features disclosed herein.